MAINTENANCE REQUIREMENTS OF THE EUROPEAN INFORMATION PROCESSING INDUSTRY 1978 - 1983

INPUT EUROPE

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MAINTENANCE REQUIREMENTS OF THE EUROPEAN INFORMATION PROCESSING INDUSTRY 1978 - 1983

JULY 1979

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1978 - 1983

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APPENDICES

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MAINTENANCE REQUIREMENTS
1978 - 1983

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I. INTRODUCTION

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I. INTRODUCTION

- The objectives of this study on Maintenance Requirements for the Information Processing Industry in Western Europe were closely modeled on those of INPUT's earlier study on the same topic in the U.S.

- The basis of the analysis were end-user and vendor questionnaires that are identical in all respects to those used in the U.S. study. Thus a point for point comparison is possible on the results of the information obtained from the two markets.

- In reality, of course, there is no such market as "Western Europe", and the markets of France, UK, West Germany and Netherlands which were analysed in the study, should be treated as separate entities in their own right. Cultural, language, business attitude, economic and other aspects are so different in each country market that until the EEC products some tangible evidence of commonality it cannot be thought of as a "common market" either.

- Nevertheless, where the data provided by the interviews was adequate and where it was meaningful from an analysis standpoint, Western Europe averages and extrapolations have been provided.

- The results of the study provide insights into:

  - user requirements for maintenance services in practical terms, exploding the myths of some of the long-held, traditional vendor views,

  - the competition that exists in the market place for maintenance services, by vendors of equipment and third party organisations,

  - the major maintenance personnel issues in the service organisations active in the market today,

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STUDY INTERVIEW PROGRAMME

- Countries covered : West Germany, France, UK, Netherlands.
- Vendor interviews with :
  - EDP Mainframe vendors
  - Terminal manufacturers/distributors
  - Minicomputer vendors/distributors
  - Third party Maintenance vendors
  - Vendors of specialised equipment using minicomputers as the central processor.
- End user interviews with :
  - Large user companies (by size of revenue)
  - EDP Managers in the main
- Interviews carried out in :
  - French, Dutch, German and English
  - face to face (20%) and telephone (80%)
- Total interview sample :

	ACTUAL	FULLY USEABLE
END-USER	453	186
THIRD PARTY/VENDOR	30	17

EXHIBIT I-1

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- the marketplace trends in all areas that affect system maintenance, be they hardware, system software or application software,

- the differences that exist in reguirements for service of terminals, peripherals, minicomputers, small business systems, medium and large scale mainframe system,

- the size of the total market, in Western Europe and the four country markets analysed, for maintenance services and for the main equipment categories.

- To provide the interview base, over 450 large end user installations were contacted in the four country markets; (this introduces a strong "large user" bias into the results, but this is partially off-set by the fact that many of the establishments interviewed operate as independent entities, and as a result have small and medium user attitudes).

- For the majority of these end users, it was a new experience to be interviewed on their views on maintenance services. Many do not log their equipment's performance, know what their contractual agreements are, measure how much they effectively spend on service or have meaningful opinions on equipment performance in general. As a result many of the questionnaires reflected this lack of knowledge.

- Country end user attitudes to maintenance varied enormously. In France few users had clear ideas on maintenance service norms, their own system requirements or the service available from vendors other than their own. In Germany either the user had complete data available, (and provided it willingly) or had incomplete data (and was reluctant to provide it). In the UK, opinions were often given that were sometimes difficult to evaluate in terms of their relationship to actual requirements or experience.

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- Vendor interviews were problematic for other reasons. While vendors were anxious to participate, on the whole, their time was also heavily committed, and scheduling interviews was a difficult and lengthy task. This resulted in the delayed preparation of the final report.

- Efforts have been made to include as much of the data collected during the study as possible. However, due to lack of time, on the one hand, and the desire to follow the report format committed to, on the other hand, some of the information obtained has been left out.

- For this reason, and for the clarification of the data provided to clients of the study, INPUT encourages comment and questions on the data presented and on topics related to the Maintenance Requirements in Europe. Where it is desired, a formal presentation of the survey findings can be scheduled.

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II. EXECUTIVE SUMMARY

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II. EXECUTIVE SUMMARY

- European vendors of equipment of all types face a series of conflicting requirements over the next five years:

  - high demand for, and good growth of equipment of all sizes, from very large mainframes to minicomputers and terminals,

  - steadily increasing demand for greater performance and larger configurations per site,

  - user demand for curtailment of increases in maintenance charges, combined with a reluctance to assume responsibility for much of the maintenance workload,

  - rising labour costs and travel costs for the field engineering force, while parts costs stagnate.

- There is no clearly identified strategy, among all vendors interviewed, other than IBM, of how they will product the maintenance field staff efficiency improvements that are required to match the demand created by continual high levels of sales.

- Contrary to the U.S. Vendors interviewed by INPUT in its companion study of Maintenance requirements in that marketplace, there is a clearly defined policy on behalf of all European vendors interviewed to restrict (or even freeze) field maintenance staff numbers.

- Even if this policy were reversed tomorrow, there are no obvious sources of large numbers of potential new hires to fill the gap.

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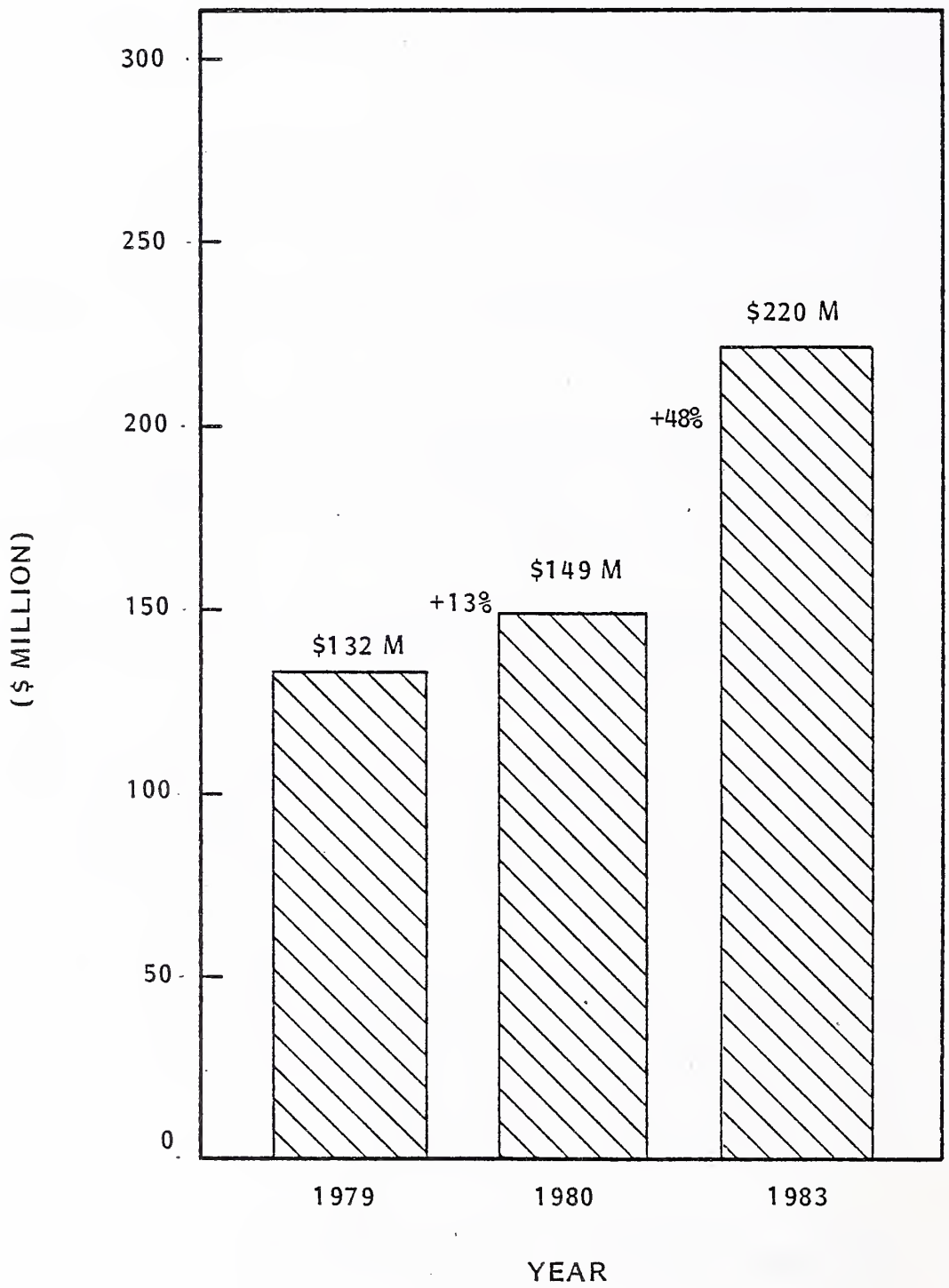
EXHIBIT II-1

RESPONDENT USERS' PROJECTED
INFORMATION PROCESSING EXPENDITURES - 1979-1983
EUROPE
(UK, WEST GERMANY AND HOLLAND)



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- It seems likely, therefore, that while European demand for EDP equipment will continue at today's high level, the quality of maintenance services provided will, on average, decrease.

- Users have already identified maintenance service quality as a major equipment selection ctireria and, as in other industries, are quite prepared to pay a premium for hardware from vendors who either have a reputation for reliability or who provide a high quality hardware maintenance support. Users are not prepared, however, to pay exhorbitant charges for the latter.

- This is an ideal situation for third party maintenance vendors who will be able to capitalize on the user need for cheaper/better performance hardware maintenance service:

  - on the one hand equipment manufacturers will be expanding the total potential market for TPM services very rapidly, (through the growth of their installed base),

  - on the other hand these same manufacturers will be unable to meet user demand for improved service at a lower cost, and may even be forced to provide a degraded performance, on average, compared to today's level of service.

A. INFORMATION PROCESSING EXPENSE GROWTH

- There were two categories of response to questions concerning the users own evaluation of the anticipated growth of information processing expenditure to 1983:

  - those users who could only provide 1978 budget values and a percentage estimate of growth over the next five years,

  - those users who possessed a five year plan of expenditure, as well as a 1979 budget and who could answer questions on growth with monetary values, which implied a certain percentage growth.

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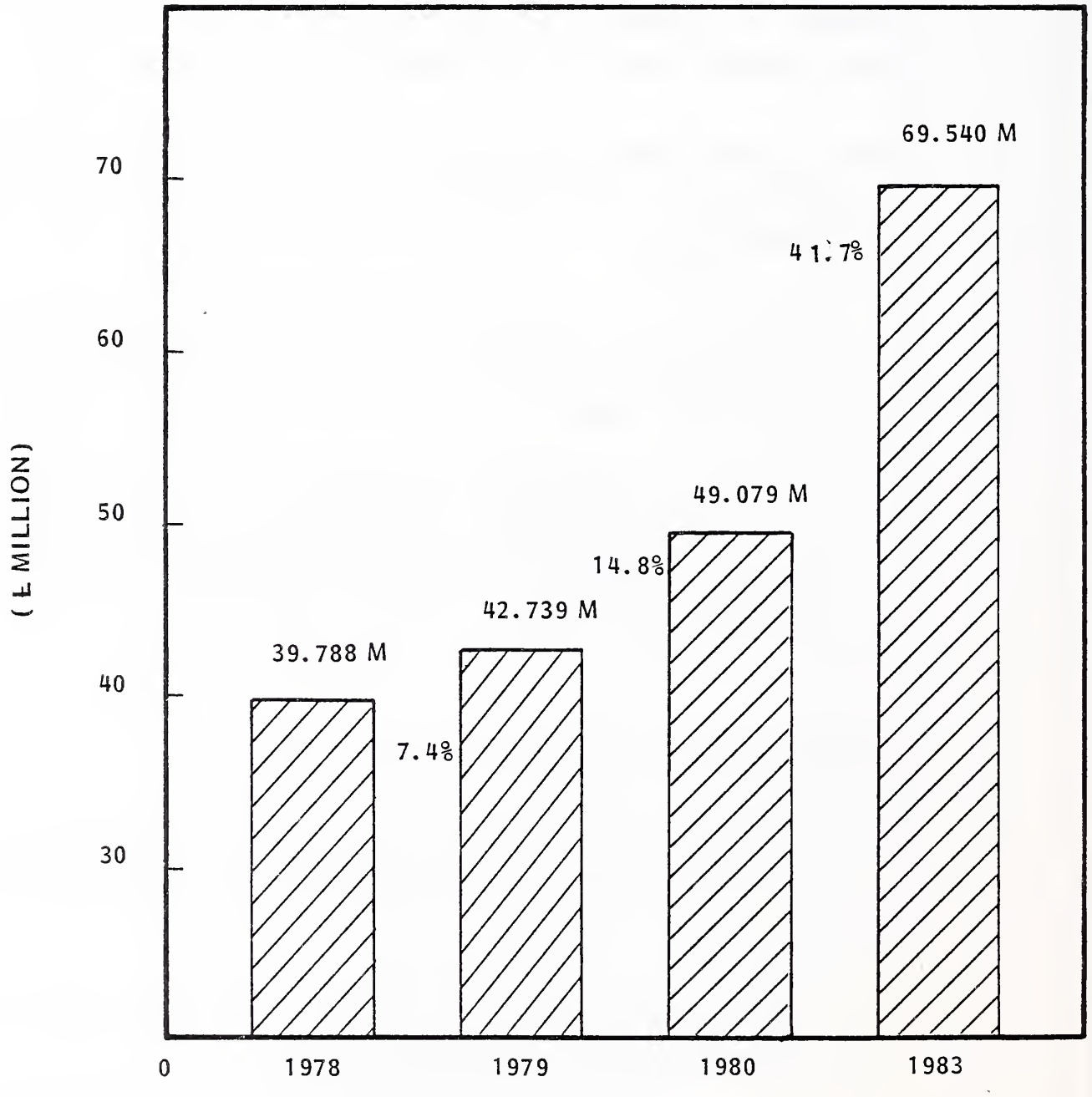
EXHIBIT II-2

RESPONDENT USERS PROJECTED

INFORMATION PROCESSING EXPENDITURES

1978 - 1983

U.K.



NUMBER OF RESPONSES: 43

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- Not surprisingly, the extrapolation of the two samples do not agree in any one country nor across the board. It is INPUT's view that the sample of respondents who possess five year plans are the most reliable and this sample has been used to product Exhibits II-1, 2, 3 and 4.

- The French sample could only provide values for 1978 and 1979 (i.e. no data for 1980-3). France has been eliminated, therefore, from II-1, when producing the summary data.

- With this reservation in mind, end user growth expectations are for a 13% rise from 1979 to 1980 and an average annual compound growth rate of 14% from 1980 to 1983. The actual values shown in Exhibit II-1 relate to the total value of information processing expenditure of the users interviewed and have no particular significance, other than to show the size of the sample.

- On a country basis the growth values vary slightly but all show a gradual increase of the next five years. The patterns of growth vary, however:

  - in the U.K., (Exhibit II-2), the sample shows a small rise in 1979 EDP expenditures over 1978, but a planned growth in 1980 of twice the 78/79 value - 14.8%; over the 1980 - 83 period the average growth rate shows a slower rate of 12%,

  - in West Germany (Exhibit II-3), a 9.2% growth is planned for 1980 over expenditures in 1979, but an average growth of 18% is expected between 1980 and 1983,

  - in Holland (Exhibit II-4), 1979 growth over 1978 was a big 17%, but planned expenditure in 1980 is less than ten percent above 1979 values; growth to 1983 is expected to pick up once again for an average of 14% per annum,

  - in France, as previously explained, only 1978 and 79 data was provided by end users; this data shows slightly less than 12% growth.

- This data is analysed by company size in section IV of this report.

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EXHIBIT II-3

RESPONDENT USERS' PROJECTED
INFORMATION PROCESSING EXPENDITURES
1979 - 1983
WEST GERMANY

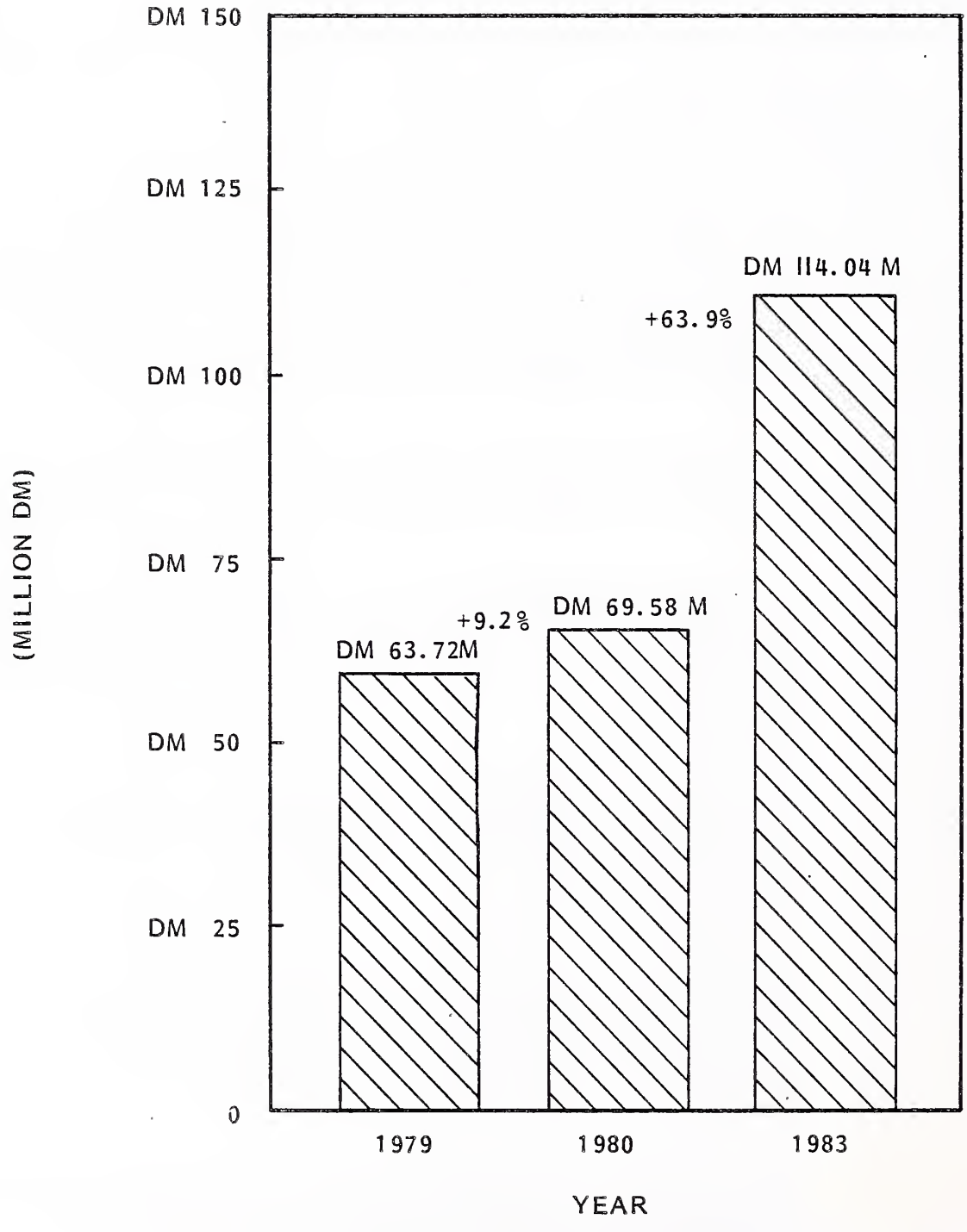

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EXHIBIT II-4

RESPONDENT USERS' PROJECTED
INFORMATION PROCESSING EXPENDITURES
1978 - 1979
FRANCE

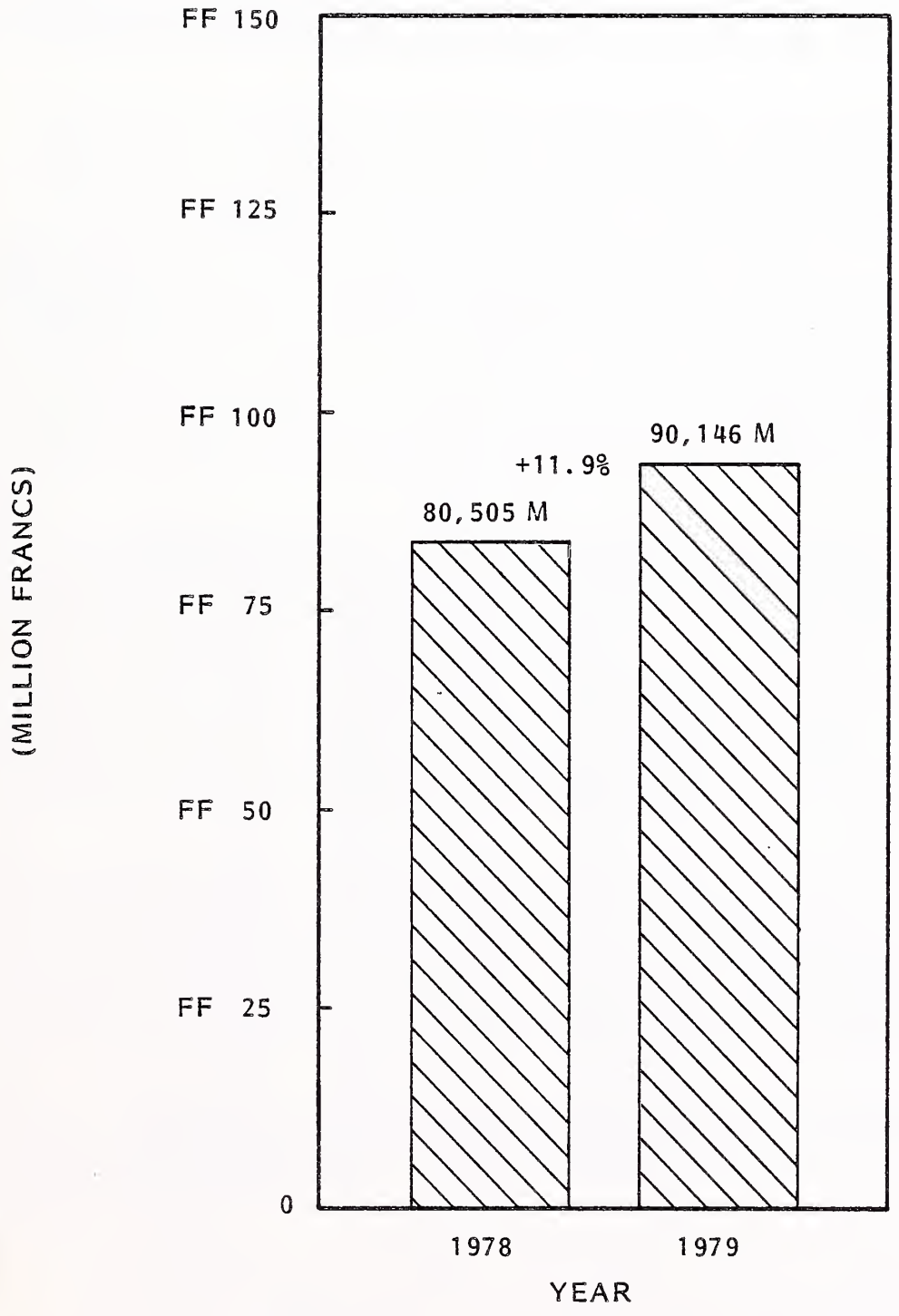

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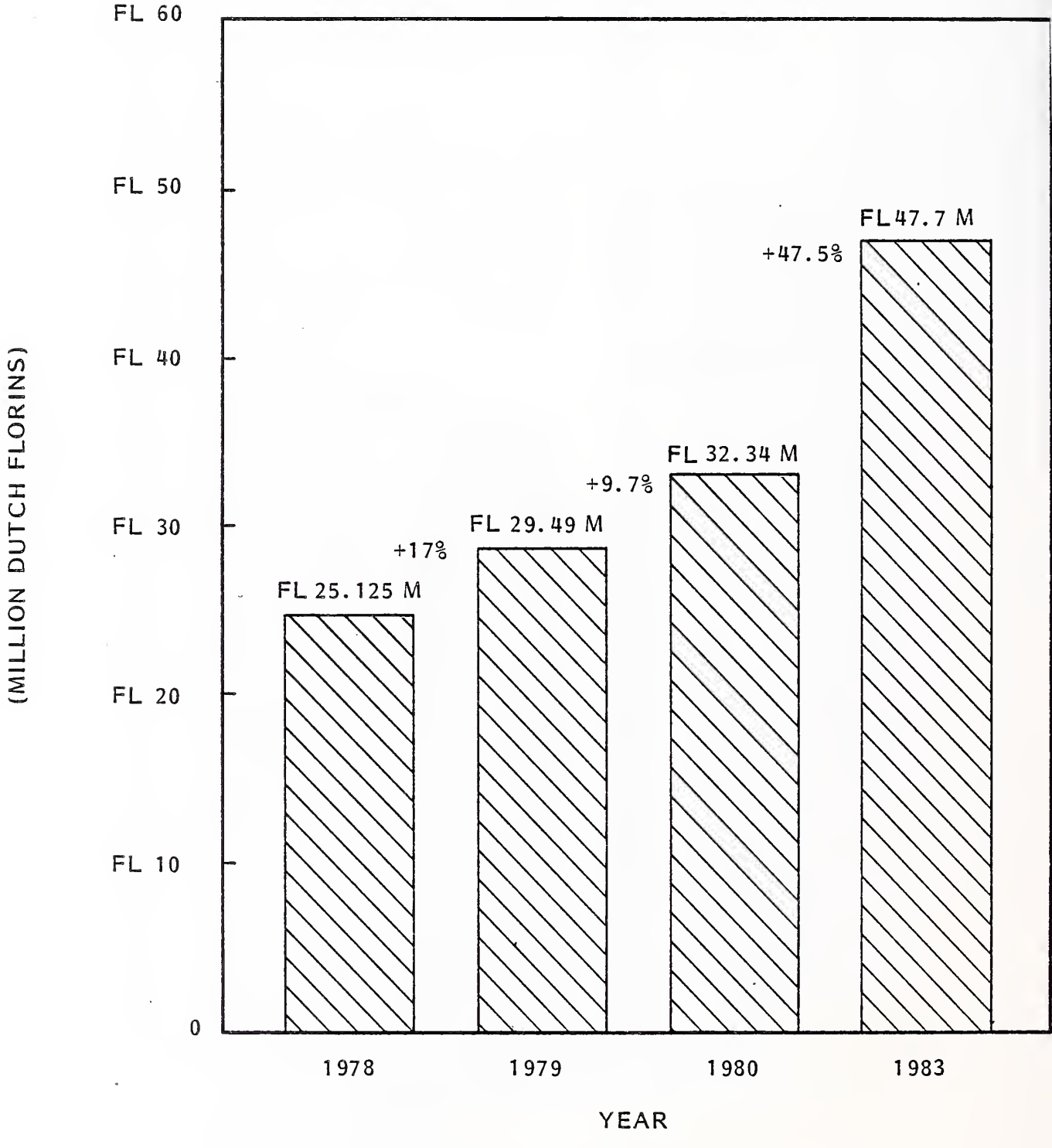
EXHIBIT II-5

RESPONDENT USERS' PROJECTED
INFORMATION PROCESSING EXPENDITURES
1978 - 1983
HOLLAND



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B. USER ATTITUDES TOWARDS MAINTENANCE

- First of all, European end users prefer to use the maintenance services offered by the vendor of the equipment they have chosen, and only seek alternatives if they (i) are driven to it by exceedingly bad performance, or (ii) can obtain significant cost reductions by adopting a third party vendor.

- Meantime to respond is a key user criteria for evaluating the maintenance performance of a vendor. (It would seem that European end users have come to accept the idea that systems reliability will never be what they want it to be, and so the maintenance service offered is growing in importance for choosing hardware). The most important factor in this maintenance service is how quickly the vendor can respond to a call: from that point on, the user feels that the problem is in the right hands, (even though he may then learn from the engineer that his system will be down for several hours).

- The minimum acceptable mean time to respond varies significantly by type of equipment: whereas users of large and medium sized mainframes would like to obtain a response of less than 1.5 hours, they accept more than 3 hours of terminals, on average. However, this picture varies also by country: in West Germany, end users wish to obtain a response to calls for maintenance problems in less than two hours for all equipment.

- Downtime, when it exceeds acceptable limits is sufficient motivation for replacing equipment: nearly a quarter of the users surveyed have replaced hardware of one type or another over the past two years because of excessive downtime, an indication of a growing problem vendors are facing.

- Users attitudes towards accepting a heavier share of the maintenance support required is unambiguous:

  - they accept that certain maintenance functions can be practically carried out by themselves, but would expect substantial cost reductions for doing so,

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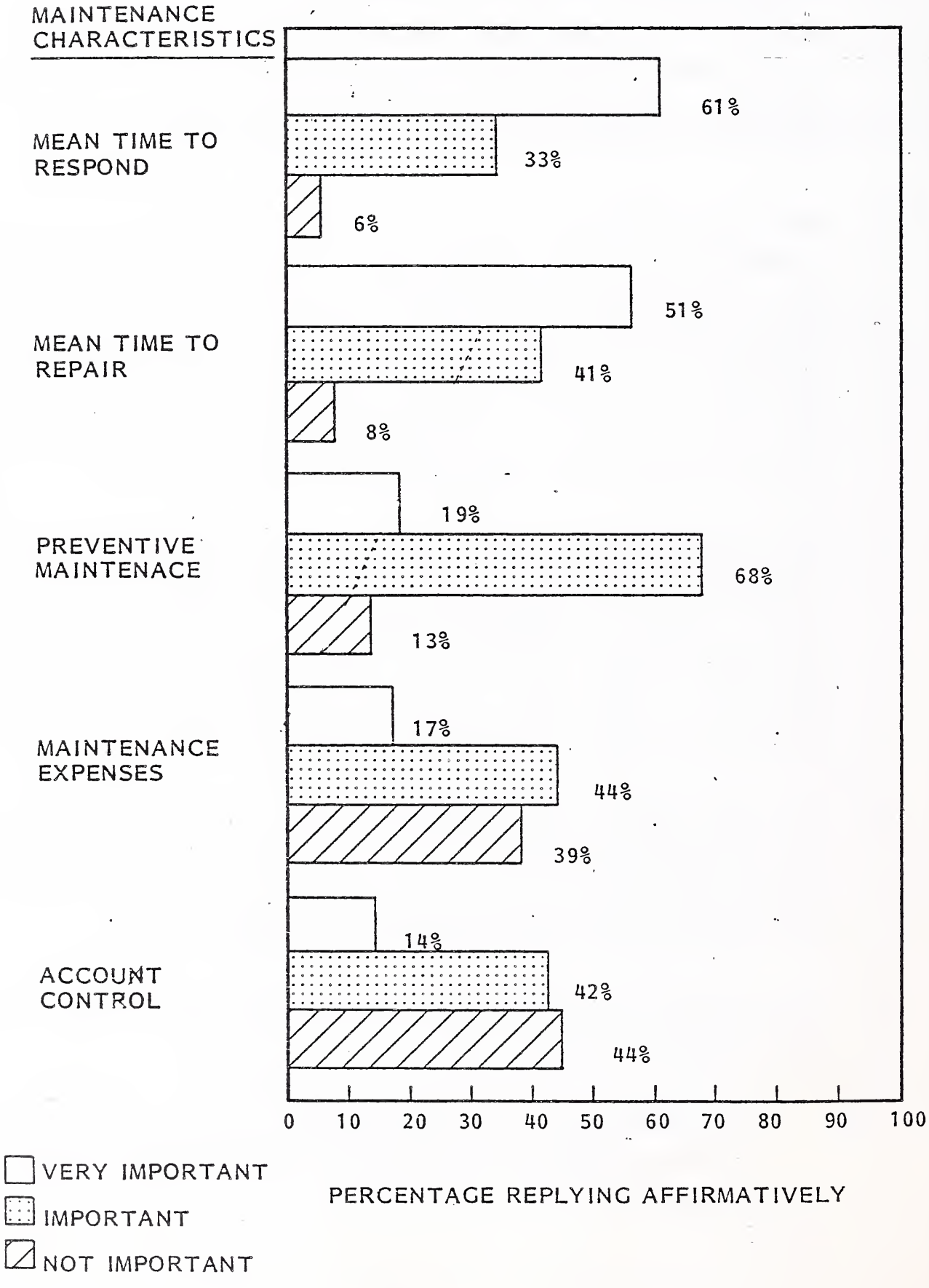
EXHIBIT II-6

RESPONDENT USERS' RATING OF THE IMPORTANCE
OF FIELD MAINTENANCE CHARACTERISTICS
EUROPE



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- they refuse to reduce functions such as preventive maintenance, (even if the cost of maintenance would be reduced), because they believe that is is necessary for the performance of their equipment, (and accept to see it carried out in prime shift time),

- they expect the vendor to ensure that the equipment he provides functions properly and will replace him if he fails to perform.

- There is a significant population of users who are dissatisfied with the response time provided by vendors and most are willing to accept slightly higher maintenance charges (3-8%) to obtain an improvement in this area.

- Most users expect mean time between failures (MTBF) to be in excess of one month and would like equipment to last more than that; few expect six months or more (although this could not be regarded as an extravagant requirement).

- Minimum acceptable mean time to repair varies, on average from 3.3 to 4.6 hours, according to the type of equipment, again a very reasonable requirement. In West Germany, however, users have decided that certain equipment (small business computers and terminals) should be able to be repaired within two hours, but accept longer periods for large/medium mainframes and minicomputers.

- In terms of maintenance contract formats, the vast majority of users would prefer to have a standard contract rather than a "time and materials" approach.

- Third party services are becoming an increasingly viable option with fewer users opposed to the idea "on principle" than uptil now. Cost savings is the main motivator although performance improvements are almost systematically achieved.

- Users see the following means as important in improving the maintenance service they receive:

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- better response time (easily the most important),
- improved parts availability,
- better diagnostics,
- better preventative maintenance,
- increases shift coverage.

All of these items, except the last one, imply better service for the same price.

- Users are also not willing to spend more than 3-7% more than today's rates for improving the mean time to repair; they generally feel it is up to the vendor to provide a better service for the same price.

- A two-shift/five days coverage covers 52% of user requirements and three shift/five days covers 71%. It is therefore logical for vendors to have a dramatically different tariff for service beyond this level of coverage.

- In general users anticipate small maintenance price increases in 1980 compound with 1979 (between 3.4% and 6.8% over today's rates).

C. MARKETING AND COMPETITIVE ISSUES

- Maintenance service has become a positive and a negative marketing and competitive tool:

  - positive in that good product reliability and fast, effective maintenance service is worth a price premium for the equipment marketed.

  - negative in that poor reliability combined with poor maintenance service (note that both need to be present to have a serious impact) can determine the removal of the equipment already installed, despite the fact that the vendor whos equipment is on site has an enormous advantage of all other vendors, even if they are far cheaper.

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- Competitive pricing of maintenance services has yet to really become an issue between equipment manufacturers, but is a fact of life for the third party maintenance vendor. The latter is still regarded by the equipment manufacturers as posing no serious threat.

- The subjective evaluation, by the equipment vendor, of the quality of his maintenance service compared to the competition is not caried out by the vendors interviewed. The main source of data seems to be "hear say" information from sales/marketing of what each vendor offers plus a (partial) evaluation of the costs involved, rather than a comparison of what each vendor achieves in maintenance service.

- Maintenance usually contributes from 20-30% of the total revenue of equipment vendors and has a correspondingly high potential for increasing/decreasing overall company profit/loss performance. Equally important, however, is the very significant impact that maintenance service can have on (i) the growth of sales (ii) replacement losses to competition (iii)company image (iv) pricing.

- Competitively inferior hardware can be successfully sold on the basis of system uptime. In this connection it is important to note that users are not too concerned as to the relative weights of "hardware reliability and maintenance service", providing that the sum of the two provides them with the required uptime.

- It is therefore crucial that the clients' perception of system availability be catered for, rather than the equipment vendor's own criteria for system performance. This approach seems to be intimately linked with the proposal of maintenance services tailored to the users needs, rather than offering standard contracts.

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D. SPARE PARTS

- In Europe, the crossing of country frontiers results in tax levies on the value of the goods entering/exiting. The creation of specialized spare parts depots in any one given country or the use of standard country inventories of spare parts kits can result in these taxes being payed for more than once.

- The most common solution is to hold such equipment in bonded wharehouses (usually Amsterdam, at Schiphol Airport), where equipment can be received from (and forwarded to) the U.S. and most major European cities by direct airflight without incurring Dutch taxes.

- Shortage of spare parts is a constant dilemma with those vendors interviewed , and results in frequent cannabalization of systems in stock, (to begin with on a "temporary" basis). The items most frequently found in stock are those that have low failure rates or which are obsolete.

- Repair of supposed deffective boards is also a slow process, although many vendors have recently implemented (or plan to implent) workshops which specialize in a given category of boards, spares or repairs.

- Increasing the spares shortage is the fact that a high proportion of those returned as deffective have no deffect at all, and were changed by the on-site engineer because they "could" cause the problem he was called to rectify.

- The spares shortage is acute enough to be visible to the end user who identified this as one of the reasons for reduced system uptime.

- The long term solution must lie in improved diagnostic aids and equipment, and in improved training for the field engineer, both of which will increase the hit rate on on-site problem identification.

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E. THIRD PARTY MAINTENANCE

- The third party maintenance business in Western Europe is a rapidly expanding one, and highly profitable despite:

  - lower maintenance revenue from each client site than that normally paid to the equipment manufacturer,
  - for high salaries paid to the field engineering (and all other) staff,
  - better morale of the field staff compared to that of the equipment vendor,
  - greatly improved maintenance services provided to the end user.

  This gives some measure of the degree of inefficiency of the large maintenance staff organizations of the major equipment vendors with the possible exception of IBM.

- TPM vendors in Europe are divided into two groups:

  - those that primarily concentrate on a small number of large/medium-sized end user installations,
  - those that are prepared to maintain a broad variety of products from terminals to micro computers, peripherals to whole systems.

- From the vendors interviewed it would appear that the highest profitability is achieved by the former group, possibly due to the greater control that can be exercised on a smaller number of accounts.

- The TPM vendor's strength is their ability to tailor their maintenance services to the requirement, which can include:

  - large, complex, mixed vendor end user sites,
  - older hardware, supported on a partial basis (or not at all) by the equipment manufacturer,

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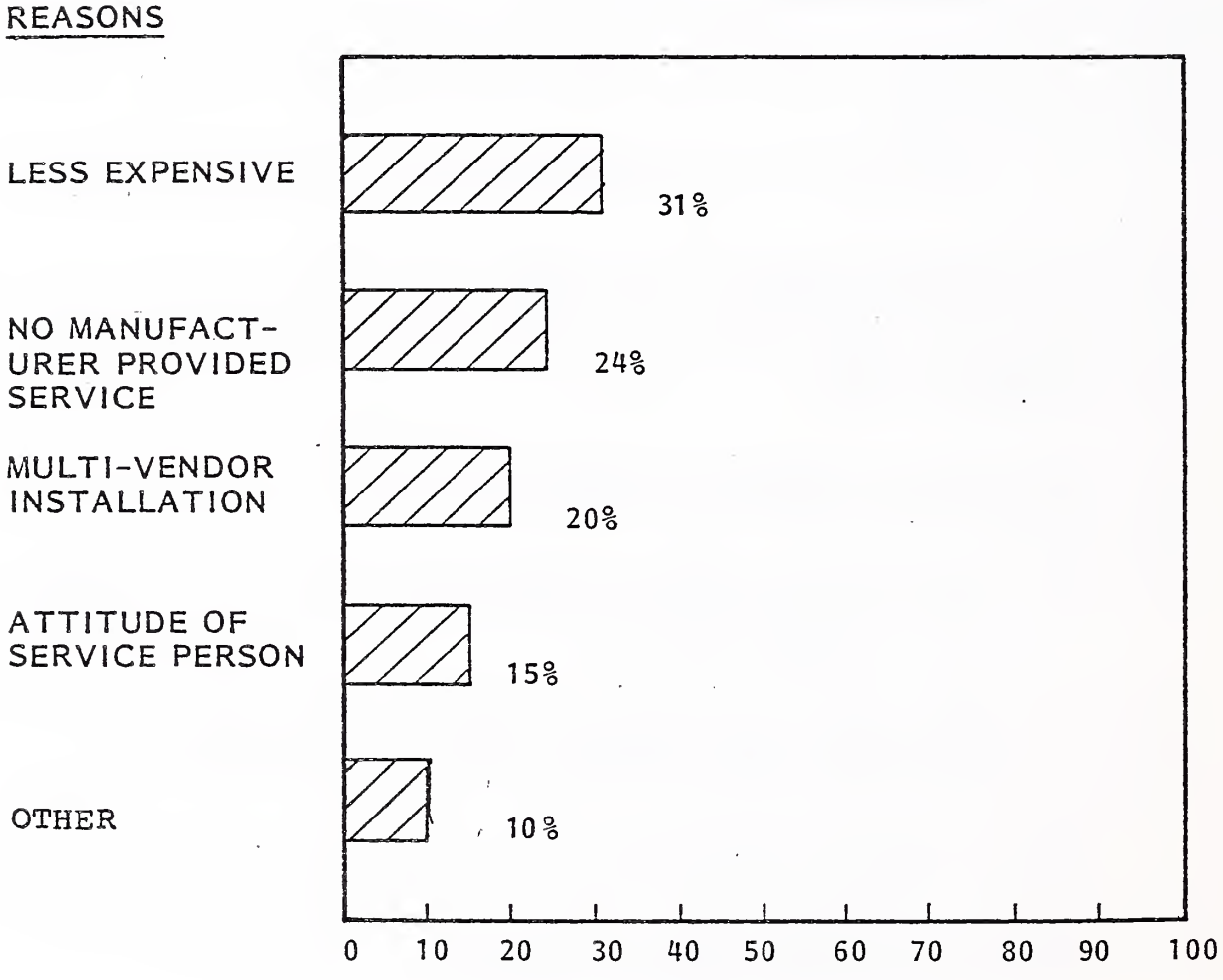
EXHIBIT II-7

REASONS FOR RESPONDENT USERS' CONSIDERATION OF UTILIZING THIRD PARTY MAINTENANCE SERVICE

EUROPE



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- all manner of hardware being introduced for the first time into European Markets by foreign vendors (usually, through not exclusively U.S.) who are not established in Europe.

- The TPM vendor image, in the eyes of non-users, is that of a high risk option to equipment manufacturers services, however bad the latter may be.

- Nearly all of the equipment vendors interviewed thought they could enter into the TPM business "at a later stage". This has to be seen as wishful thinking: none of the vendors interviewed could justify how they will meet the growing service requirements generated by their own hardware, let alone be in a position to support someone else's.

F. PERSONNEL ISSUES

- As in the United States, the crucial problem for all European maintenance organizations is finding, hiring, training and retaining new field engineers; there are no plans in hand, amongh the vendors interviewed, that would dramatically enhance the productivity of current engineering staff.

- Many of the larger vendor maintenance organizations are populated with senior staff, so that annual retirements are creating a steady drain on engineering ressources. In addition internal losses (e.g. the lateral transfer of engineering staff to, say, marketing functions) are a one-way street: very few transfers occur from other departments in the company to the maintenance department.

- Given the scarcity of new hires, (and the perceived pressure of third party maintenance organizations offering very attractive salaries and conditions), there is a growing tendency to accelerate the move of young inexperienced engineers up the long promotion ladder, often before they are equipped to take on new responsibilities. This is disruptive in three ways:

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- older staff resent the accelerated access to status and pay levels that they had to wait longer for,
- the quality of service provided drops in certain areas due to inexperienced staff,
- the younger engineers don't want to see this initial acceleration of pay and benefits stopped, and look to move when it does.

- Maintenance goods, performance monitoring, staff discipline and the overall management of field engineering staff is not good. Incentive programs are no replacement for lack of organization and the clear identification of what is expected from each staff member.

- Field engineering is still perceived within the average vendor organization as a second class career (by those outside of it). New hires, in particular, see Marketing as glamourous, Sales as well rewarded, Programming as challenging and intellectually satisfying - and field engineering as boring and lacking in corporate visibility.

- Add to this the fact that most of the major field service organizations are very large in size, and it can be seen that many candidates think they will be losing their identity, "becoming a number".

- The inevitable promotion to supervisor or manager of the very successful field engineer is still being practised even though (i) he may not have managerial qualities (ii) he may not enjoy his new functions (iii) the company loses the specialist skills he has, because there is no longer time available for him to use them.

- Job guidance, goal setting, performance monitoring and feed back to the staff can be sources of real job satisfaction to staff if implemented sensibly; beating a goal, visibly, means more than a standard pay rise at year end that is not related to achievements.

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G. SOFTWARE MAINTENANCE

- The gradual inclusion of basic system software support into the basic field engineering role of hardware support is an accepted fact with most of the large mainframe vendors. The extension of this support role to include maintenance functions such as the implementation of new versions of operating systems, updates etc has not yet happened, however.

- There is no doubt that application software support will remain within Marketing, but it may be necessary for the entire workload of system software maintenance and support to be handled by field engineering.

- This does not necessarily mean that software-trained maintenance staff will leave to join the programmers ranks: by 1983 much of the basic system software will be accomplished in hardware - a highly optimised, firmware-based type of programming that will be very remote from the high level language programming of the applications programmer.

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III. PRESENT STATUS OF THE INFORMATION PROCESSING EQUIPMENT MAINTENANCE FUNCTION

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III PRESENT STATUS OF THE INFORMATION PROCESSING EQUIPMENT MAINTENANCE FUNCTION

- Maintenance, like system software, was initially provided as a necessary adjunct of selling hardware: something which was required after the equipment sale had been achieved, but that had very little influence on achieving the sale in the first place.

- Additionally, there was no competitive aspect to maintenance services. Each vendor provided service according to his own view of what was required, but did not compare his services with those of other vendors. Users rarely cancelled an installed system for poor service, except in those cases where the system failed completely.

- Now, not only is maintenance service crucial to a company's image, part of the initial competitive evaluation in the eyes of a user and critically appraised on an on-going basis, but it has become a significant element in the overall revenue and profit generated by information processing equipment vendors.

A. MAINTENANCE AS A REVENUE GENERATOR

- Actual percentages vary, but equipment vendors receive from 15 to 30% of their total revenues from maintenance services, and this proportion is increasing. It is therefore mandatory that this source of revenue be adequately monitored.

- Surprisingly few of the top executives in charge of the maintenance function in European vendor organizations have:

  - precise data on the installed base of products they are maintaining,
  - the volume of revenu that is being generated,
  - the breakdown of the major component parts of the revenue generated.

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- Equally serious is the fact that profitability is also inadequately controlled: since many executives do not have profit responsibility but only revenue responsibility, they are (i) not motivated (ii) not given authority to effect those changes that can enable a continued improvement of profit performance.

- Frequently financial policies that affect the profitability of the maintenance function are decided elsewhere: e.g. are spare parts inventories depreciated rapidly/slowly? Are they part of the maintenance cost or treated as overhead?

- The majority of the field maintenance executives are therefore mainly concerned with:

  - maintaining customer complaints at a low level,
  - limiting the growth in costs to a reasonable value,
  - keeping the level of knowledge/expertise of the field engineers on a par with the changing technologies of the products they must support,
  - retaining maintenance staff and keeping them motivated in a "non-glamourous function".

- Field engineering is labour intensive and is therefore an increasing cost for all vendors. Interest is high in productivity schemes and in reducing travel time (and other non-productive activities) through remote diagnostics, user self-sufficiency, replacing deffective modules on-site and repairing off-site etc.

B. RELIABILITY AS AN EVALUATION/SELECTION FACTOR

- As in all other industries, a reputation for product reliability develops very slowly, cannot be changed rapidly and tends to attach itself to a company name (rather than to a product or line of products from a vendor).

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- The impact on product selection is intangible (but considerable) and an increasing number of "buy" decisions rate reliability above price. This is just as important to large systems vendors as for minicomputer vendors, (except that an increasing proportion of software factors dominate the thinking of large system users).

- It is important to note that, in the average users mind, "reliability" is missused: users really think in terms of uptime, i.e. the combined result of product reliability and maintenance service. It would seem that they have accepted that hardware products do not perform to their requirements by design, and need continuous adjustment, in the same way that they have accepted that standard software products rarely match their needs precisely.

- Vendors that have achieved this global status image of selling "reliable" products are few: only IBM and Hewlett Packard were mentioned by users. This provides a significant boost to the launch of any new product, even before it has been installed.

C. PRODUCT MAINTENANCE SERVICE SOURCES

- Apart from the mainframe manufacturer, all product vendors are being faced with the problem of the cost of distribution, though this is not the place to analyse this topic.

- Combining maintenance service with marketing/sales/support is ideal, but generally impractical, when dealing through distributors, agents, retail stores or computer services companies. "Throw-away" or highly reliable products can go this route: computers, however small, are neither yet.

- Third party maintenance in European is very patchy in its product coverage and in country market coverage. Whereas the United Kingdom is well served and France to a lesser extent, West Germany is not covered at all. In addition, whereas certain obsolete lines or mainframes, or certain restricted numbers of multi-vendor sites have coverage, TPM is by no means a systematic option for all users. As a result, there is very little alternative for the average user, who must live with the maintenance service provided by the vendor of the equipment he has chosen.

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D. TECHNIQUES PRESENTLY USED FOR PROVIDING MAINTENANCE SERVICE

- Due to increasing labor costs, techniques for providing maintenance service are slowly being modified. Some recent incorporated changes and new techniques include:

  - Central dispatch: User problem calls are answered by a nationwide or regional dispatch center. "Call queues" are maintained on a computer system.

  - System support centers: Provide technical support for hardware and software and respond to either end user or field engineer inquiries.

  - Radio dispatch: Maintains radio communications with field engineers. Field engineers may spend up to 50% of their working time in car travel and cannot be reached otherwise during this period.

  - Remote diagnostics: With the utilization of communications facilities and on-line computers it is possible to perform fault isolation tests remotely. If a service call is required, the field engineer is dispatched to the machine site.

  - Customer operated diagnostics: Vendors are providing software programs that will allow the user to test the system for accuracy. Although such test programs may not isolate faults, they will determine if the problem is in the hardware or the application program.

  - End users performing board swap: Utilization of local and remote diagnostics and training can create an environment whereby the end user replaces faulty boards with an on-site spare.

  - For smaller devices having quantity installations at a single location (e.g., POS, modems, hand held wands, terminals, etc.), a variety of programs are in effect to eliminate service calls. Some examples are

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1) Mailing the defective unit to a repair depot or plant.

2) Delivering the product to the local branch or repair depot.

3) Accumulating a number of faulty devices for scheduled periodic on-site service calls.

- Field engineers are instructing end users on the performance of preventive maintenance for certain simple electro-mechanical devices. Although operator care of equipment is customary, the complexity of user involvement is increasing.

- End users are encouraged to install their equipment. A large vendor who formerly tagged the shipping carton with "Do not open. Warranty will be voided", in a recent announcement of a new computer stated "... the user is encouraged to install this equipment. It is as easy as hooking up a stereo sound system".

- In the future, end uses are expected to be more involved with maintenance by:

  - Co-operating on testing and running diagnostics prior to placing a service call.
  - Assisting in performing remote diagnostics.
  - Self-installation of smaller devices and systems.
  - Purchasing and stocking needed on-site spares and board swapping.
  - Performing a higher level of preventive maintenance.

E. DRIVING FORCES

- There are two main driving forces for change in the structure of maintenance services in Europe:

  - labour cost are increasing by as much as 20% per annum.

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- demand for hardware seems bottomless, and the growth of sales is gradually exceeding the (slower) rate of increase in field engineer man days available.

- Productivity improvements are so far marginal and a growing shortage of engineer manpower is hitting all vendors simultaneously. The skill mix of personnel on board is also lagging behind the product mix of installed equipment, with insufficient new product skills available while a surfeit of old product skills persists.

- Personnel problems are significant in the larger maintenance organizations: attracting a large base of new generation engineers at conditions that disturb established status and salary structures, ineffectual first line management, in-house and competitive staff losses and maintaining the morale of the existing staff.

- Vendors must simultaneously face the user demand for better response times, better skilled FEs and faster availability of spares, at a time when maintaining the current level of service for the existing base is a problem in itself.

- Meanwhile there are ever increasing pressures for the FE to take on the added responsability of system software maintenance and support, which requires a new set of skills, not easily found nor developed in today's average field engineering force of senior/older people.

- European vendors main problem will be in maintaining existing service levels for an ever expanding base/mix of products, rather than chasing new opportunities. The maintenance executive has a challenging job indeed over the next five years.

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IV. ANALYSIS OF THE INFORMATION PROCESSING INDUSTRY USER SURVEY

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IV. ANALYSIS OF THE INFORMATION PROCESSING INDUSTRY USER SURVEY

- The user's view of the level of equipment performance that is satisfactory, the shortcomings of current maintenance services and the degree to which users can assist in supporting their systems are examined in this section, and differ notably from the vendor's view of the same items.

A. BUDGETED USER EXPENDITURES FOR EDP AND MAINTENANCE

- The distribution of information processing expenses, as recorded by the end users interviewed, was difficult to establish since there is no standard classification of expense categories in user budgets. Even items such as "mainframe hardware costs" do not always mean the same thing: in some cases maintenance charges are included (even when the equipment is purchased), the amount may refer to the amortization of purchase, or may be the leasing costs of the equipment.

- As a result the percentage breakdown examples provided in Exhibit IV-1 (France) and IV-2 (Germany) are not always directly comparable. However, generally speaking the breakdown appears to be:

-	Mainframe or central system including peripherals	- 25%	of total EDP budget
-	Terminals	- 6%	of total EDP budget
-	Data Communications	- 2%	of total EDP budget
-	Personnel	- 53%	of total EDP budget
-	Maintenance	- 13%	of total EDP budget
-	Other	- 1%	of total EDP budget.

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EXHIBIT IV-1

DISTRIBUTION OF INFORMATION PROCESSING EXPENSES, BY EXPENSE CLASSIFICATION, AS FORECASTED BY RESPONDENTS (1979)

FRANCE

CLASSIFICATION	1979 M FRANCS	%
MEDIUM/LARGE SYSTEMS AND MINI/SMALL BUSINESS COMPUTERS	21.89	24.3%
TERMINALS	5.5	6.1
DATA COMMUNICATIONS	1.9	2.1
PERSONNEL	48.61	53.9
MAINTENANCE	12.3	13.6
TOTAL	90.2 MF	100%

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EXHIBIT IV-2

DISTRIBUTION OF INFORMATION PROCESSING EXPENSES, BY EXPENSE CLASSIFICATION, AS FORECASTED BY WEST GERMANY

1979

CLASSIFICATION	1979 MDM	PERCENT-AGE
MEDIUM/LARGE SYSTEMS AND MINI/SMALL BUSINESS COMPUTERS	22.233	36%
TERMINALS	2.602	4
DATA COMMUNICATIONS	.555	1
PERSONNEL	33.157	53
* MAINTENANCE	3.543	6
TOTAL	62.09M	100%

* THE FIGURE FOR MAINTENANCE EXPENSES IS LOW DUE TO 11 OF 27 RESPONDENTS WHO HAVE INCLUDED THEIR MAINTENANCE EXPENSES IN THEIR MAIN SYSTEM EXPENDITURE

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- Economies of scale in computing power are an important variable in the users budget (the cost per unit of computing power of an IBM system/3 is several times higher than that of IBM system 370/168). These economies are more visible in France and the UK than in West Germany, at least for the sample interviewed.

- In very large companies the expenditures given to INPUT must be viewed as being frequently understated, because increasingly there is no one corporate respondent able to speak for the total enterprise (and knowledgeable on all expenditures that are made by the many divisions/departments in the company).

- Total growth of user expenditures by country (as an average annual growth rate between 1979 and 1983) varies considerably:

  - UK : 13%
  - Holland : 15%
  - West Germany : 21%.

  In France, few users were prepared (or able) to forecast their intentions with any accuracy.

- The intended growth of end users varies also by size of company, within country. Exhibits IV-3 (Holland), IV-4 (West Germany) and IV-5 (UK) provide an analysis of four sizes of company within each of those countries.

- By totalling the actual budgeted values for those companies who have five year plans, and examining the growth of the total values so obtained, an accurate picture of rate of growth of each category of company size is obtained (see Exhibit IV-6).

- Very large company expenditures are forecasted to grow by only 6%; this nevertheless implies a substantial increase in terms of actual dollars spent, given the size of the budgets concerned.

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EXHIBIT IV-3

RESPONDENT USERS' EXPENDITURES FOR INFORMATION PROCESSING GOODS AND SERVICES BY COMPANY SIZE
1979
HOLLAND

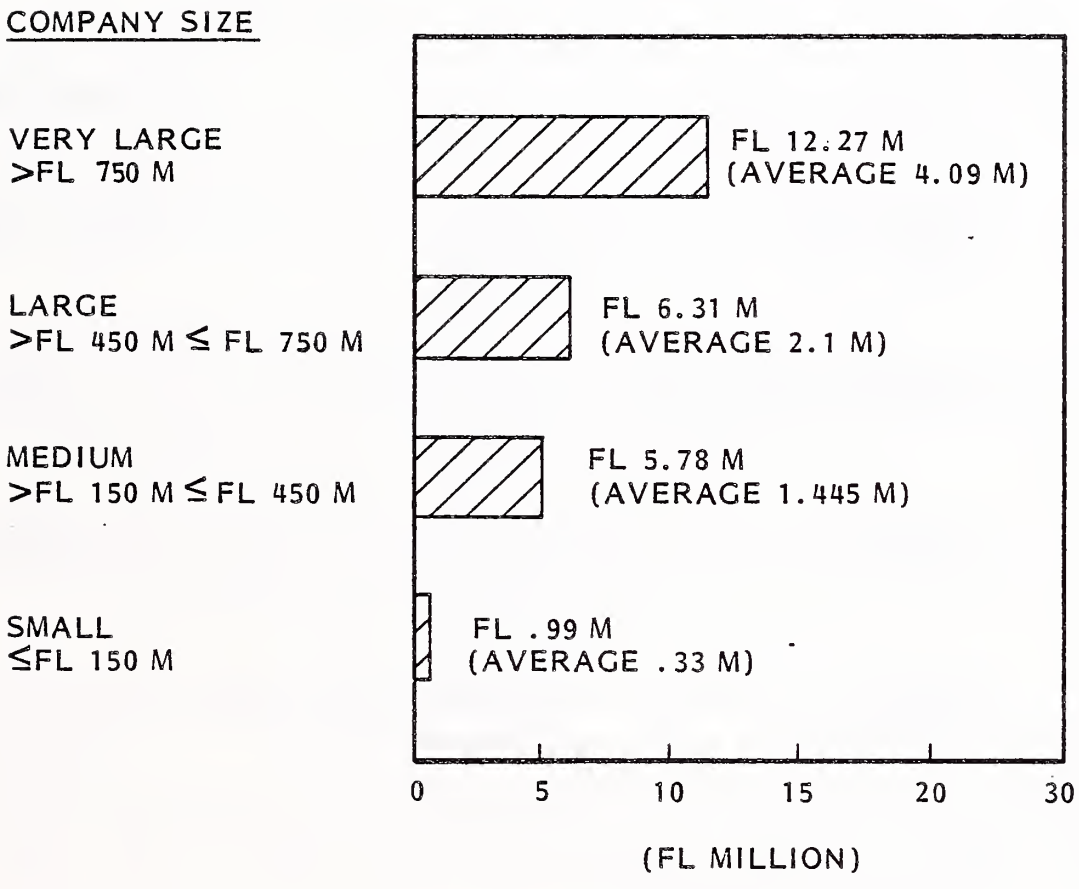

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EXHIBIT IV-4

RESPONDENT USERS' EXPENDITURES FOR INFORMATION PROCESSING GOODS AND SERVICES BY COMPANY SIZE
1979
WEST GERMANY

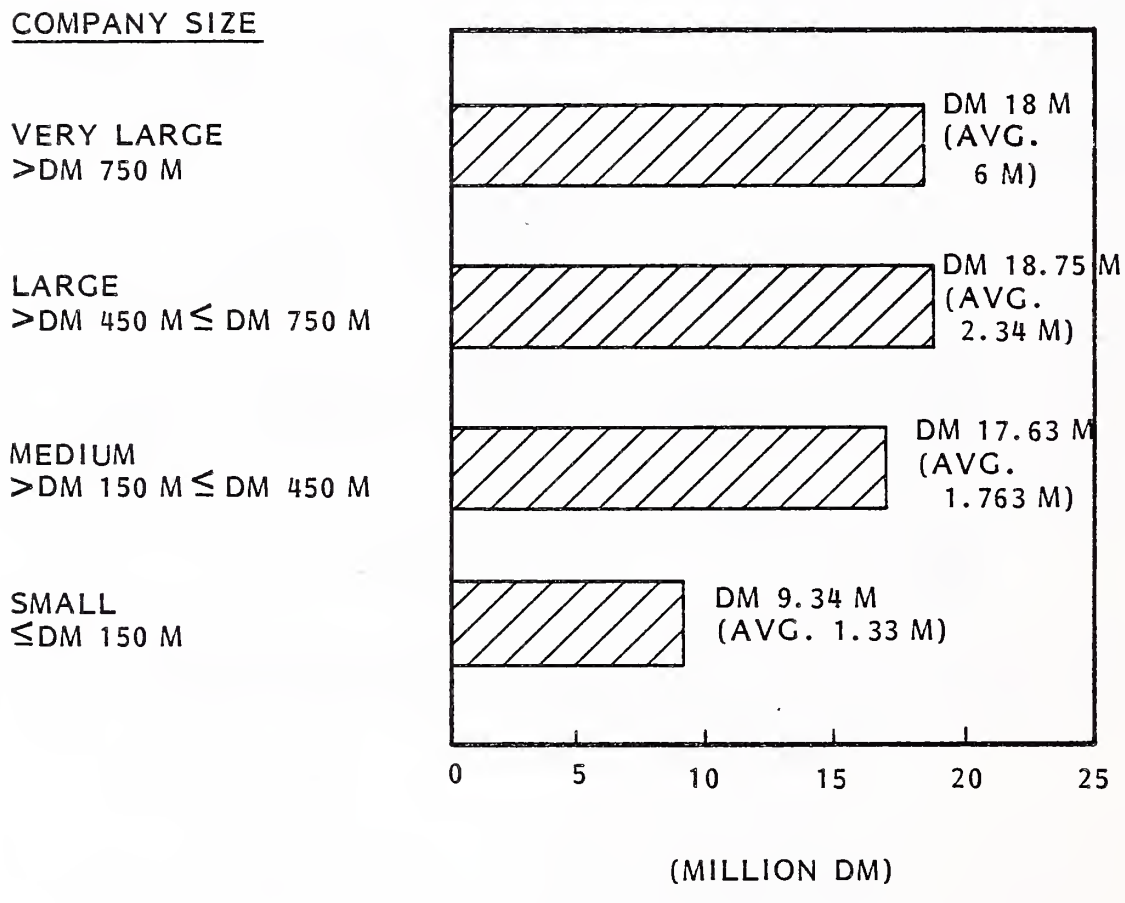

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EXHIBIT IV-5

AVERAGE RESPONDENT USER EXPENDITURES
FOR INFORMATION ON PROCESSING GOODS
AND SERVICES BY COMPANY SIZE
1979
U.K.

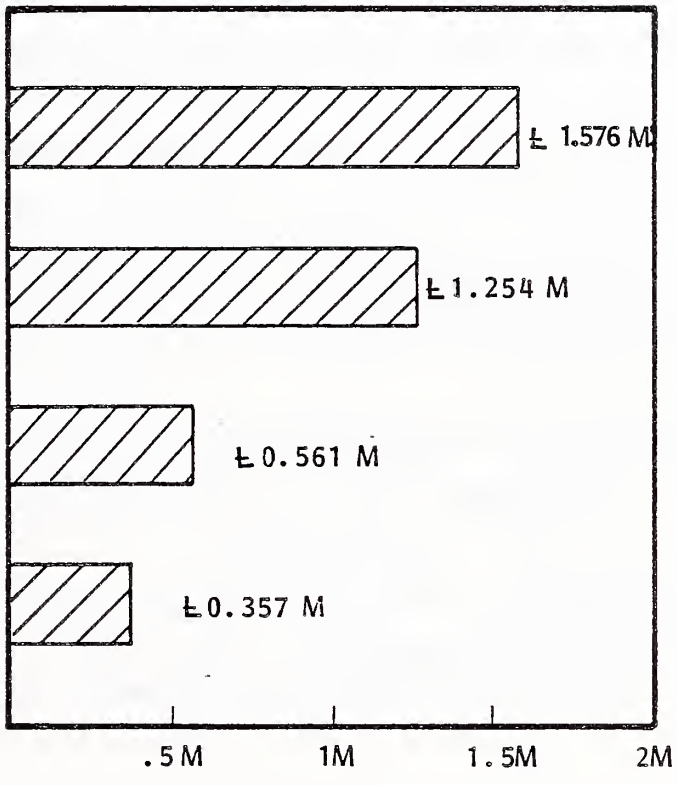
COMPANY SIZE

VERY LARGE
> £ 400 M

LARGE
> £ 100 M ≤ 400 M

MEDIUM
> £ 20 M ≤ 100 M

SMALL
≤ £ 20 M



(£ POUND STERLING)

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EXHIBIT IV-6

AVERAGE INFORMATION PROCESSING
EXPENDITURES BY COMPANY SIZE
AS FORECASTED BY
RESPONDENT USERS

EUROPE (UK, WEST GERMANY, HOLLAND)

COMPANY SIZE	1979 ($ MILLION)	1980 ($ MILLION)	1983 ($ MILLION)	AAGR (1979-1983) PERCENT
VERY LARGE > $385 MILLION	$3.419	$3.608	$4.31	6%
LARGE > $215 ≤ 385 MILLION	1.59	2.02	3.6	23%
MEDIUM > $70 ≤ 215 MILLION	1.222	1.616	2.154	15%
SMALL ≤ $70 MILLION	.518	.597	.744	9.5%

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- The large company group (greater than $215M but less than $385M) shows the fastest growth at 23%, followed by medium sized companies at 15%.

- Small companies, i.e. - those that have a turnover less than $70M per annum predict an increase of 9.5%.

- Although throughout the study end users constantly complained at the increase in maintenance costs they must face, they nevertheless expect to have to pay more in 1980, over that which they currently pay in 1979.

- The amount of increase varies by company size and by country:

  - whereas in Holland little or no increase was expected by small to large companies, the very large ones expect a 6.6% rise,
  - in West Germany, all classes of users expect to have to pay more, ranging from a low of 1.25% (large companies) to a high of 3.8% (very large),
  - in the U.K., substantial increases are expected across the board, from 7.5% (medium-sized companies) to 10% (very large companies).

- The overall result is given in Exhibit IV-7, which shows that, on average, the very large companies expect to have to pay the most, and the smaller companies far less (one half).

B. IMPORTANCE OF FIELD MAINTENANCE PERFORMANCE FACTORS TO USERS

- The European and user's preference, for maintenance services, is strongly in favour of the supplier of the hardware (see Exhibit IV-8): very few users prefer third party vendor services, or are indifferent to who provides them with service.

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EXHIBIT IV-7

RESPONDENT USERS' ANTICIPATED PERCENTAGE
OF MAINTENANCE INCREASES IN 1980 VS 1979 BY COMPANY SIZE
EUROPE

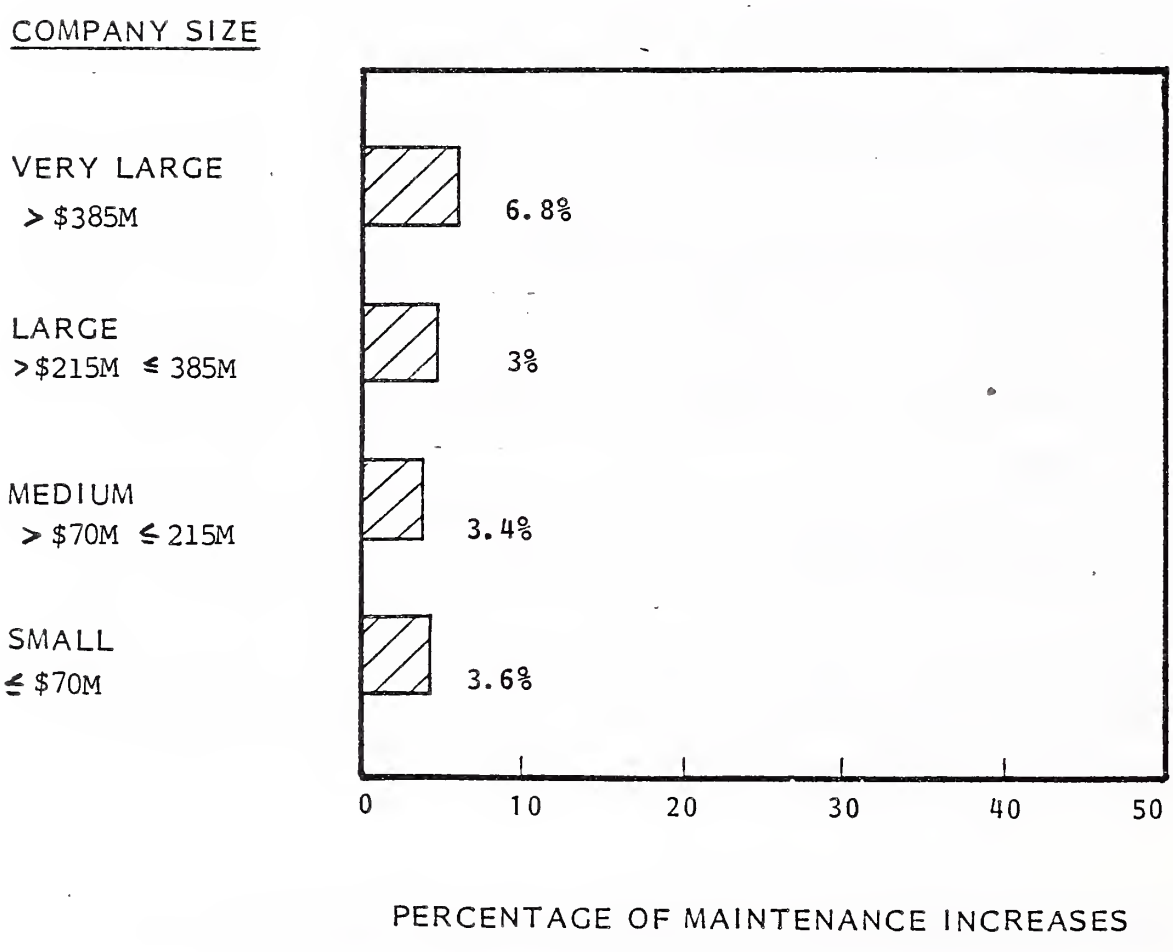

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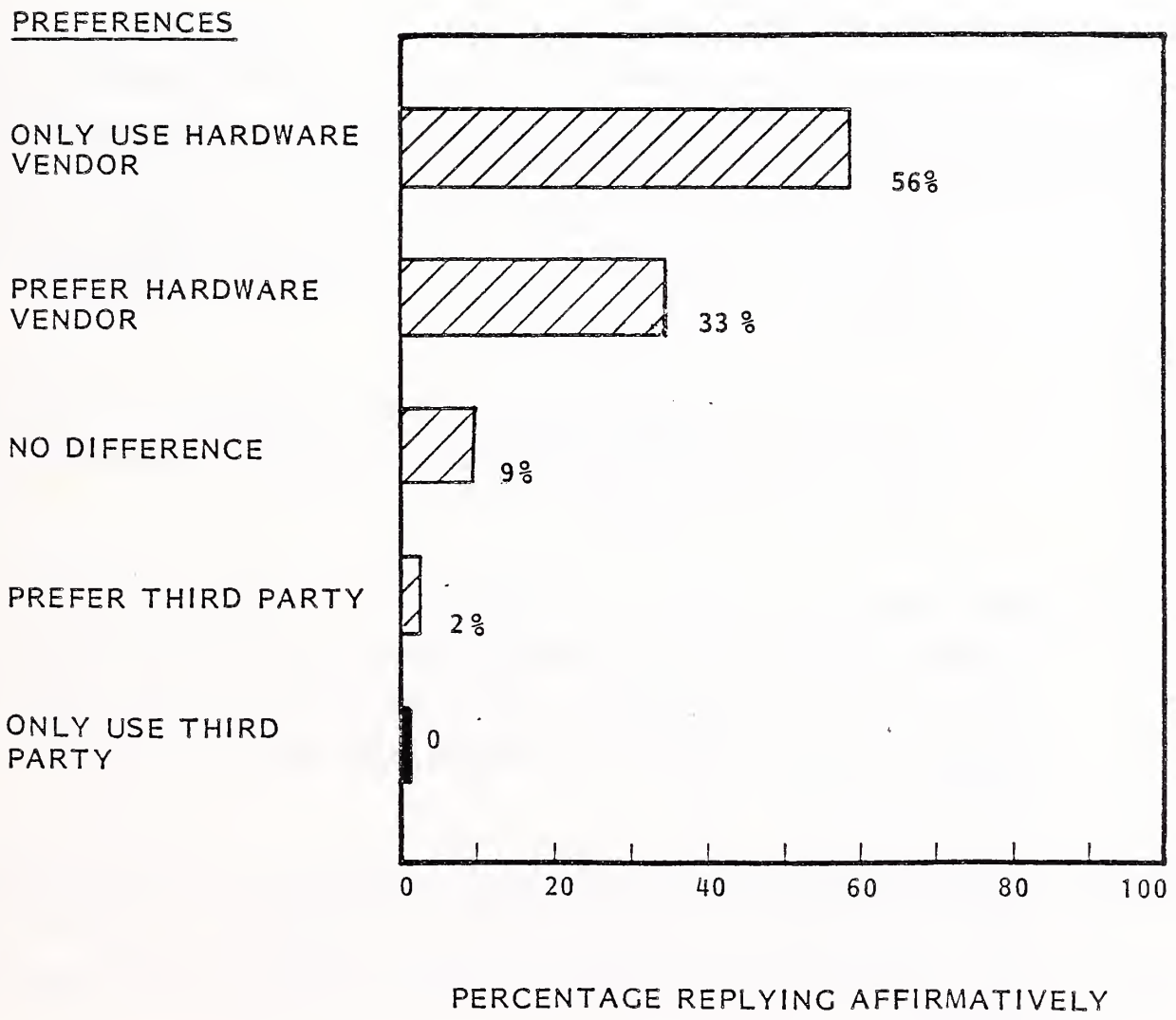
EXHIBIT IV-8

RESPONDENT USERS' PREFERENCE FOR
MAINTENANCE VENDOR

EUROPE



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- This view varies in intensity from one country to another:

  - in West Germany (see Exhibit IV-9) the vendor is expected, almost exclusively, to be the source of service; there is very little scope for third party maintenance vendors,

  - in France (see Exhibit IV-10) the attitude is far less categorical; while there is no preference for TPM, there is a more flexible consideration of alternatives,

  - in the U.K. (see Exhibit IV-11) there is a growing popularity of TPM services, though at present the numbers of clients are small; significantly (the only country of the four analysed to show this), there is a higher proportion of people who would merely prefer to use the equipment vendors services, (rather than insist upon only using such services),

  - in Holland (see Exhibit IV-12) a significant number of end users (22%) are indifferent to the source of maintenance, an indication of a latest market for TPM services.

- When examined by category of equipment use, the end user population shows no great differences in their preference for maintenance services (see Exhibit IV-13). Out of 357 responses to this question, only 2% prefer third party services, 9% have no particular preference, but a low 56% are tied to the equipment vendor.

- A further 33% of end users would prefer the equipment vendor's services, but have an eye open for alternatives if these are presented. This has to be seen as an indictment of present day maintenance services provided by equipment vendors.

- End-user classification of field maintenance characteristics in Europe are examined in Exhibit IV-14. The initial impression gained is that mean time to respond, (i.e. getting a maintenance engineer out on-site), is more important than all else. In actual fact, however, this is merely the first priority.

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EXHIBIT IV-9

RESPONDENT USERS' PREFERENCE FOR
MAINTENANCE VENDOR

WEST GERMANY

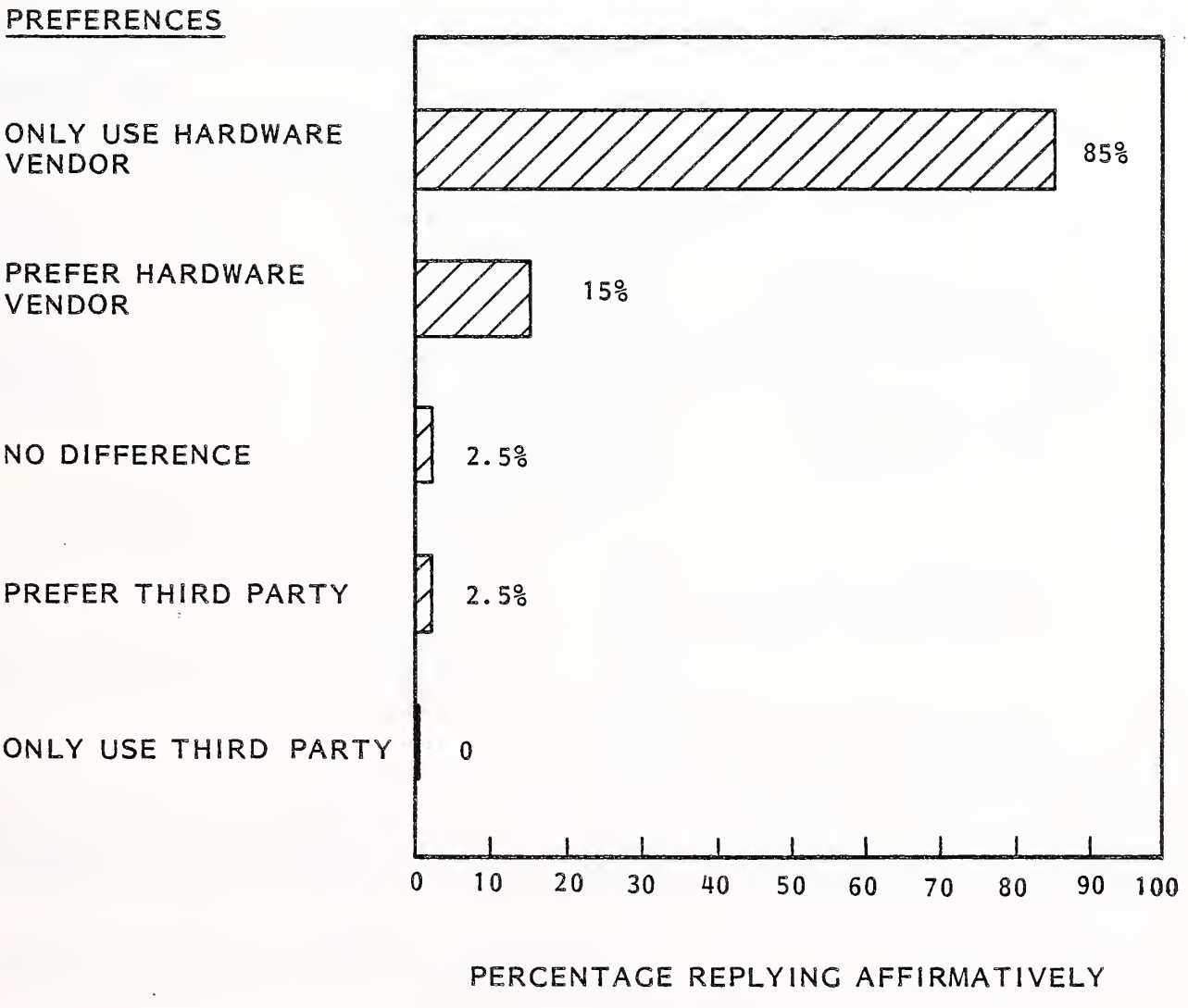

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EXHIBIT IV-10

RESPONDENT USERS' PREFERENCE FOR
MAINTENANCE VENDOR
FRANCE

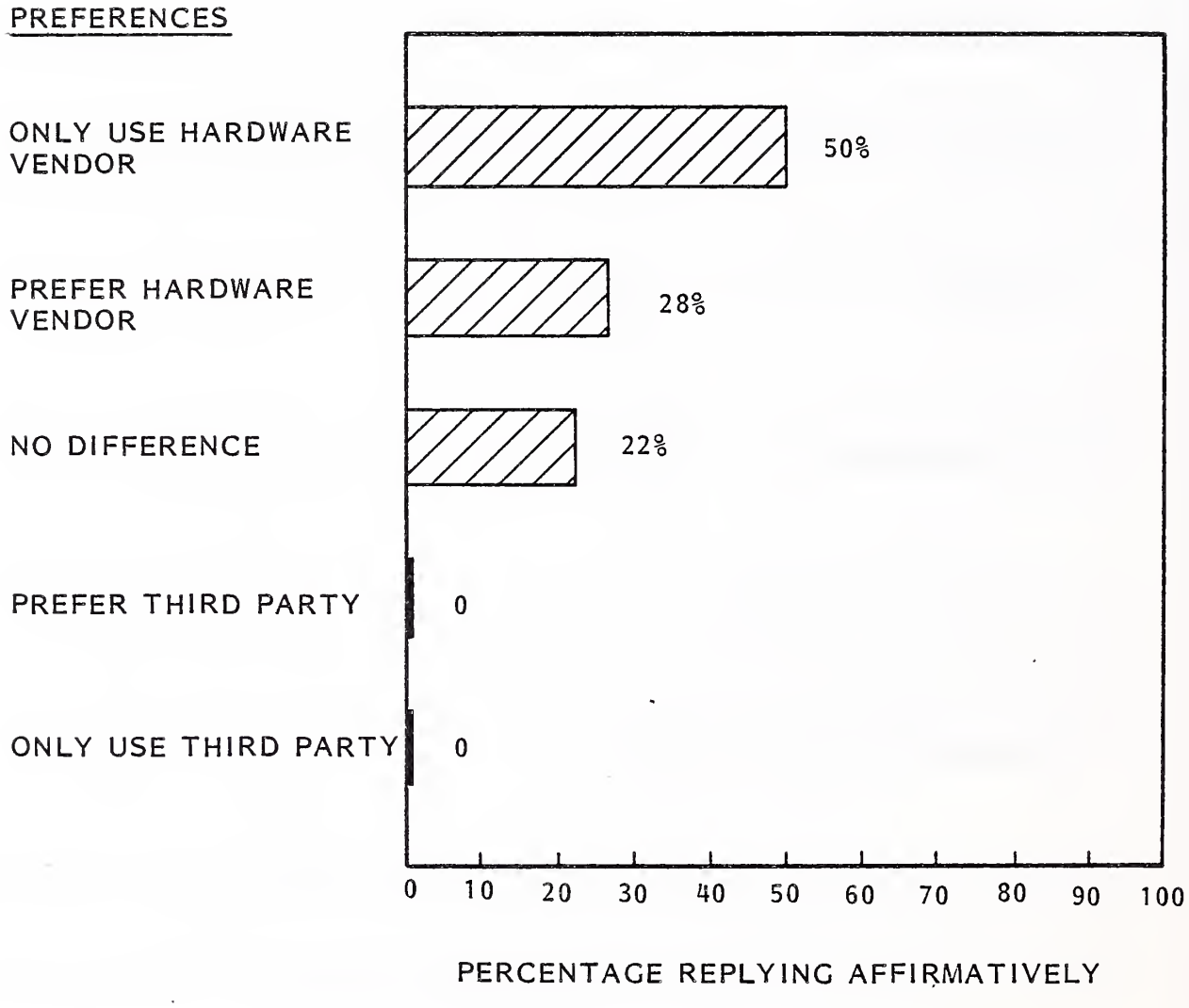

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EXHIBIT IV-11

RESPONDENT USERS' PREFERENCES FOR MAINTENANCE VENDOR

U.K.

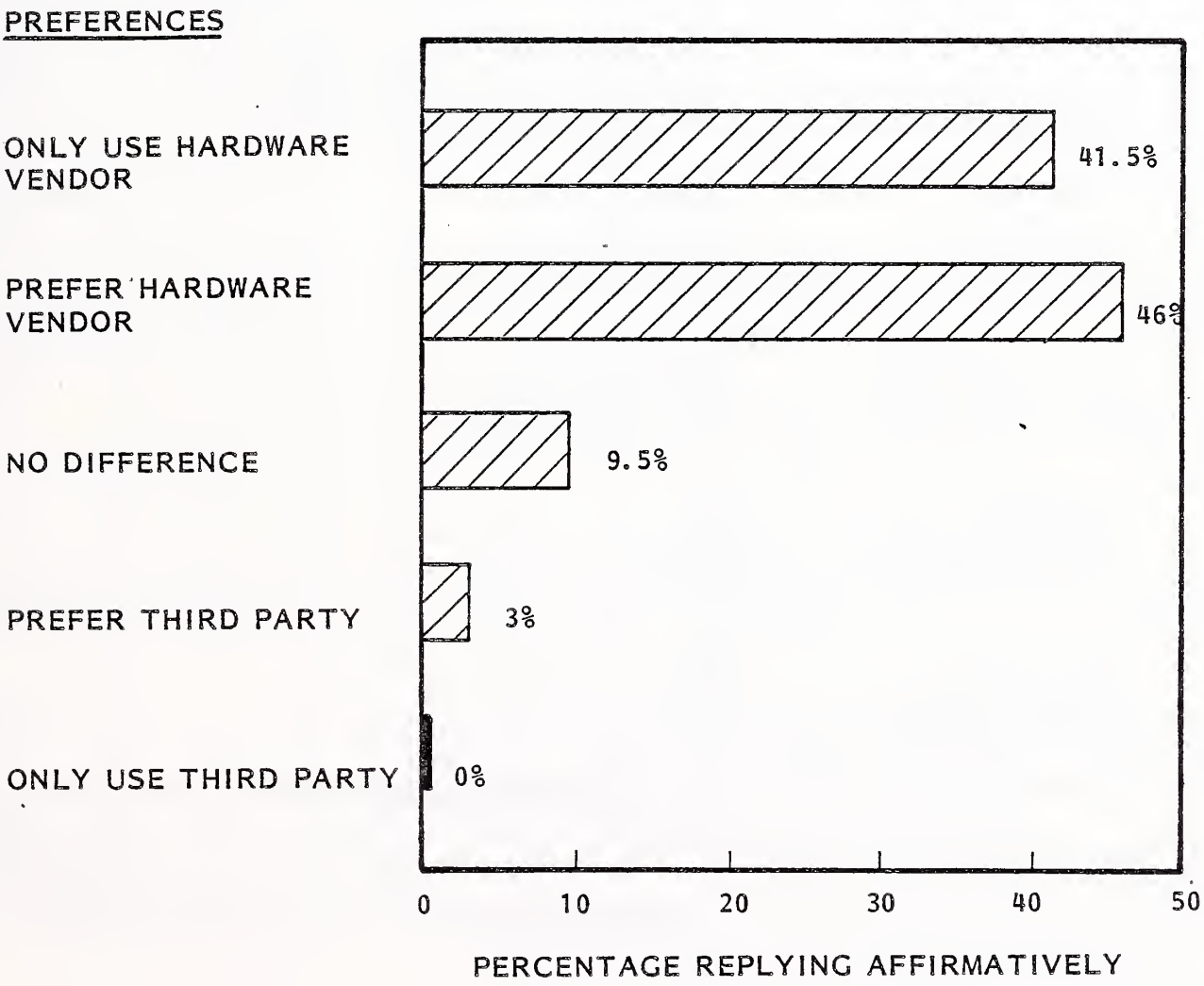

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EXHIBIT IV-12

RESPONDENT USERS' PREFERENCE FOR

MAINTENANCE VENDOR

HOLLAND

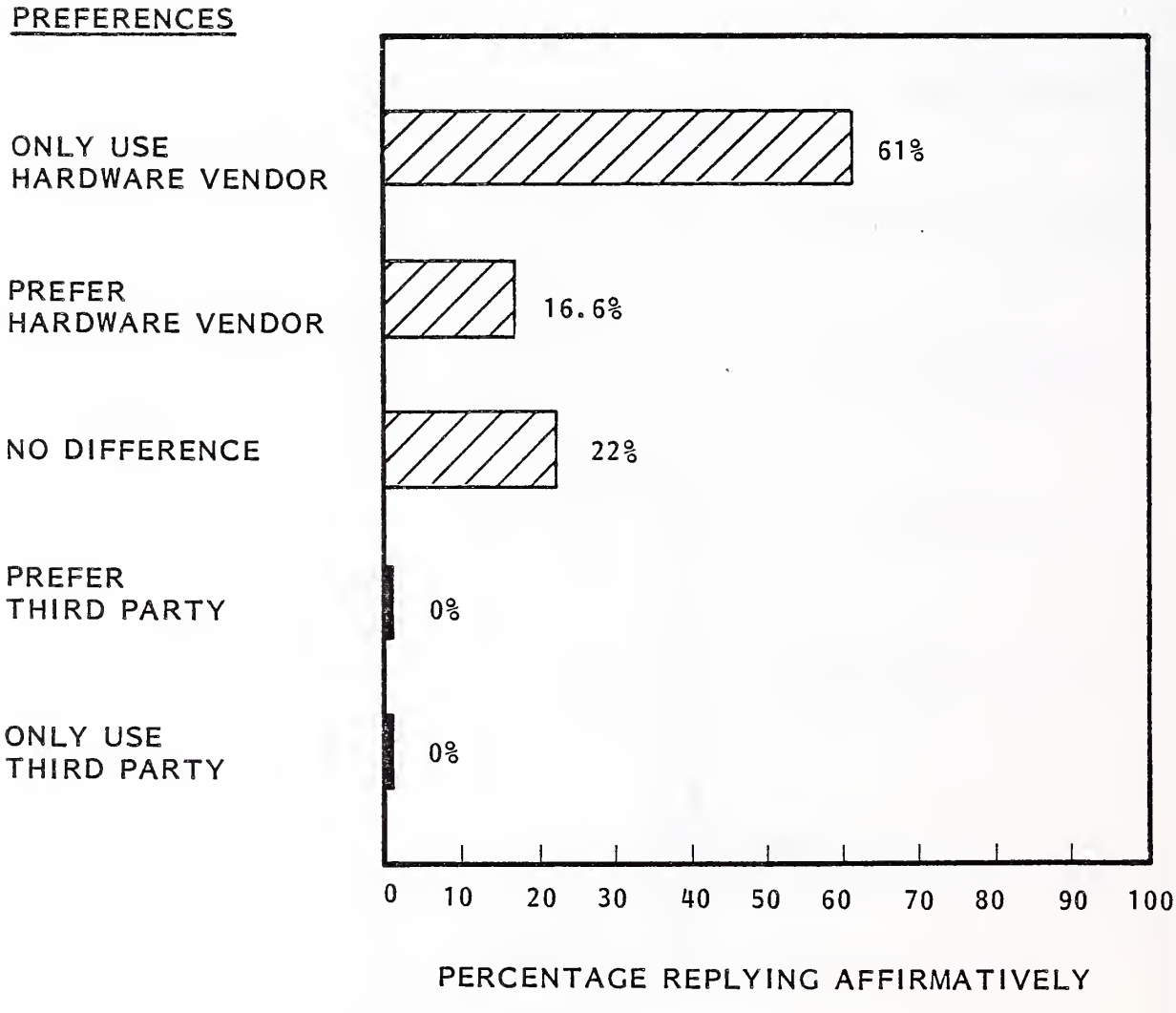

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EXHIBIT IV-13

RESPONDENT USERS' PREFERENCE
FOR MAINTENANCE VENDOR
BY TYPE OF EQUIPMENT
EUROPE

EQUIPMENT CLASSIFICATION	ONLY USE VENDOR HARDWARE	PREFER VENDOR HARDWARE	NO DIFFERENCE	PREFER THIRD PARTY	ONLY USE THIRD PARTY	TOTAL
LARGE AND MEDIUM MAINFRAMES	75	36	8	2	0	121
	62%	30%	6.5%	1.5%	0	100%
SMALL BUSINESS COMPUTERS	18	18	3	1	0	40
	45%	45%	7.5%	2.5%	0	100%
OTHER MINICOMPUTERS	19	16	5	2	0	42
	45%	38%	12%	5%	0	100%
PLUG COMPATIBLE PERIPHERALS	36	19	7	1	0	63
	57%	30%	11%	1.5%	0	100%
TERMINALS	52	29	9	1	0	91
	57%	32%	10%	1%	0	100%
TOTAL RESPONSES	200	118	32	7	0	357
TOTAL % REPLYING	56%	33%	9%	2%	0	100%

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- The second most important characteristic is the repair time. Exhibit IV-14 shows that there is little difference between mean time to respond and mean time to repair in the view of the end user: the sum of "very important" and "important" views are equivalent - 94% for response time and 92% for repair time.

- Preventive maintenance, while not essential, is considered to be important to users. Although many of the vendors interviewed were considering cutting back on the amount of preventive maintenance carried out because of a decreasing need for this activity in modern products, end users feel reassured by the regular appearance of the maintenance engineer.

- This appears to be more psychological than a practical necessity. What the user wants is a reliable system, and he feels that if preventive maintenance is regularly carried out, the system has less chance of failing. Whether the engineer's intervention in PM affects actual performance is not measured. However in some sectors of business (e.g. Government), PM is considered as part of the agreed contract and must be provided, useful or not.

- Maintenance expenses are not of primary importance, but are never far from the users mind in today's market. 44% of respondents consider it an important factor. Thus while the main problem in users minds is the reliability of his system, he is not prepared to pay unlimited amounts to achieve this.

- In a similar view, over half of the end users think that account control is a significant requirement. Many would like to feel that their specific requirements are being taken into account, rather than having on the terms of a standard contract.

- The spectrum of users, by size of company, replying to the questions is shown in Exhibit IV-15 with the number of positive answers going a high, medium or low level of importance to each question.

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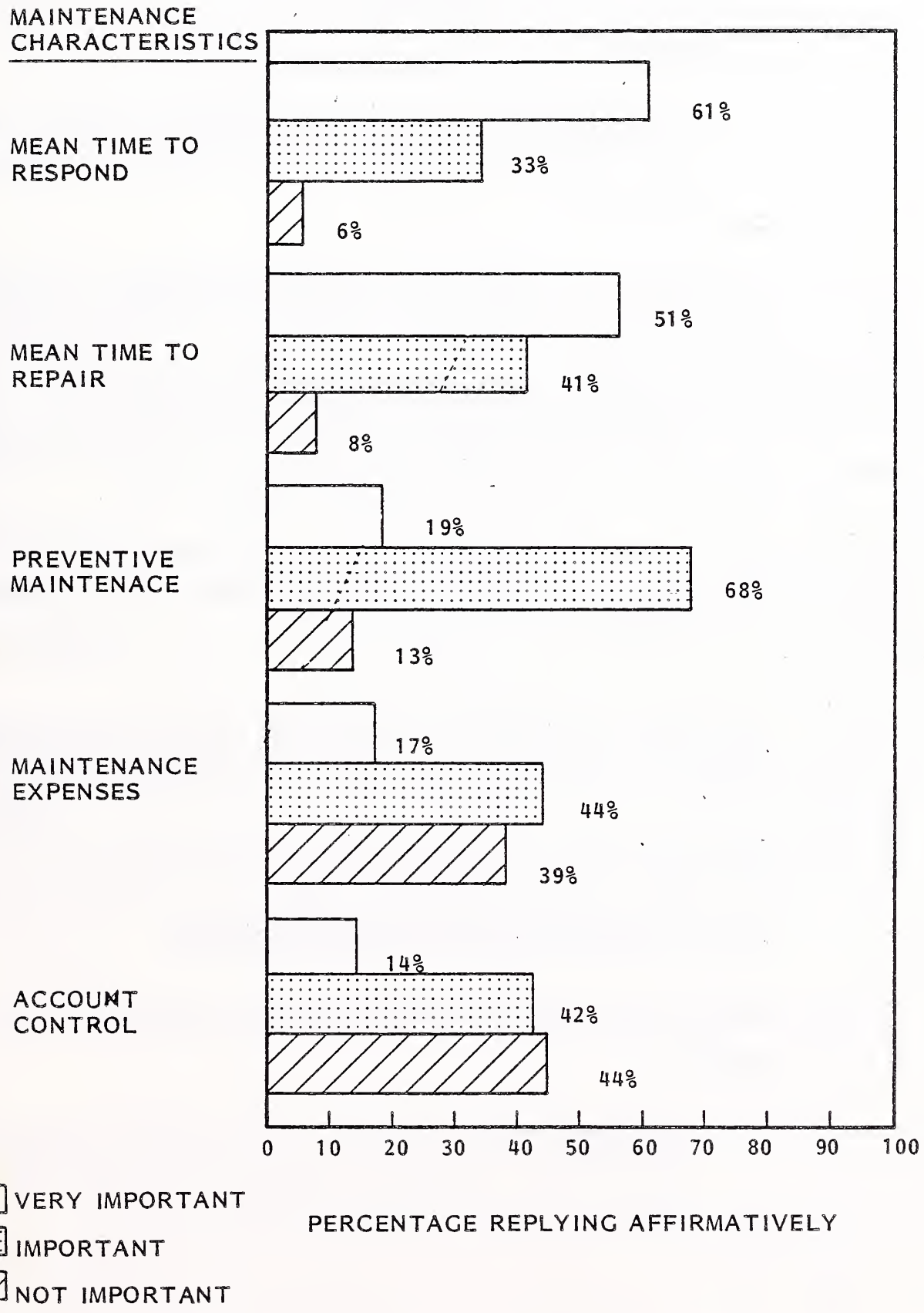
EXHIBIT IV-14

RESPONDENT USERS' RATING OF THE IMPORTANCE
OF FIELD MAINTENANCE CHARACTERISTICS
EUROPE



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- Exhibits IV-16 (West Germany), IV-17 (U.K.), IV-18 (Holland) and IV-19 (France) show the relative importance of maintenance characteristics for each country market:

  - In West Germany user expect fast response and reasonable repair time, with regular preventive maintenance the cost of maintenance is not important,

  - in the U.K., repair time is almost as important as response time; preventive maintenance is important but so is the cost of maintenance,

  - in Holland repair time is the most important factor followed by response time; preventive maintenance is considered to be very necessary, while maintenance expense has far less impact,

  - in France no clear picture emerges; response time is fairly important followed, in equal proportion, by the repair time and preventive maintenance.

C. MEAN TIME TO RESPOND: USER SATISFACTION/DISSATISFACTION AND REQUIREMENTS

- Since mean time to respond is the most important maintenance characteristic, an average, for the European end user, let us examine the degree of dissatisfaction and the user requirements in this area.

- Exhibit IV-20 describes the relative satisfaction of end users with four types of hardware:

  - mainframes, where one third of today's users are dissatisfied with current vendor maintenance response time, of which 35% would be willing to pay more to improve response time;

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EXHIBIT IV-15

RESPONDENT USERS' RATING OF THE IMPORTANCE OF FIELD MAINTENANCE CHARACTERISTICS BY COMPANY SIZE

EUROPE

MAINTENANCE CHARACTERISTICS	VERY LARGE			LARGE			MEDIUM			SMALL		
	HIGH	MED-IUM	LOW	HIGH	MED-IUM	LOW	HIGH	MED-IUM	LOW	HIGH	MED-IUM	LOW
MEAN TIME TO RESPOND	13	7	1	18	10	1	29	13	1	25	8	1
MEAN TIME TO REPAIR	14	5	2	14	13	2	20	21	1	19	14	1
PREVENTIVE MAINTENANCE	4	12	4	6	19	4	8	30	5	4	23	5
MAINTENANCE EXPENSE	0	7	11	0	4	21	1	11	27	1	6	25
ACCOUNT CONTROL	1	6	10	3	11	12	3	21	16	1	16	13

NUMBER REPLYING AFFIRMATIVELY

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EXHIBIT IV-16

RESPONDENT USERS' RATING OF THE IMPORTANCE
OF FIELD MAINTENANCE CHARACTERISTICS
WEST GERMANY

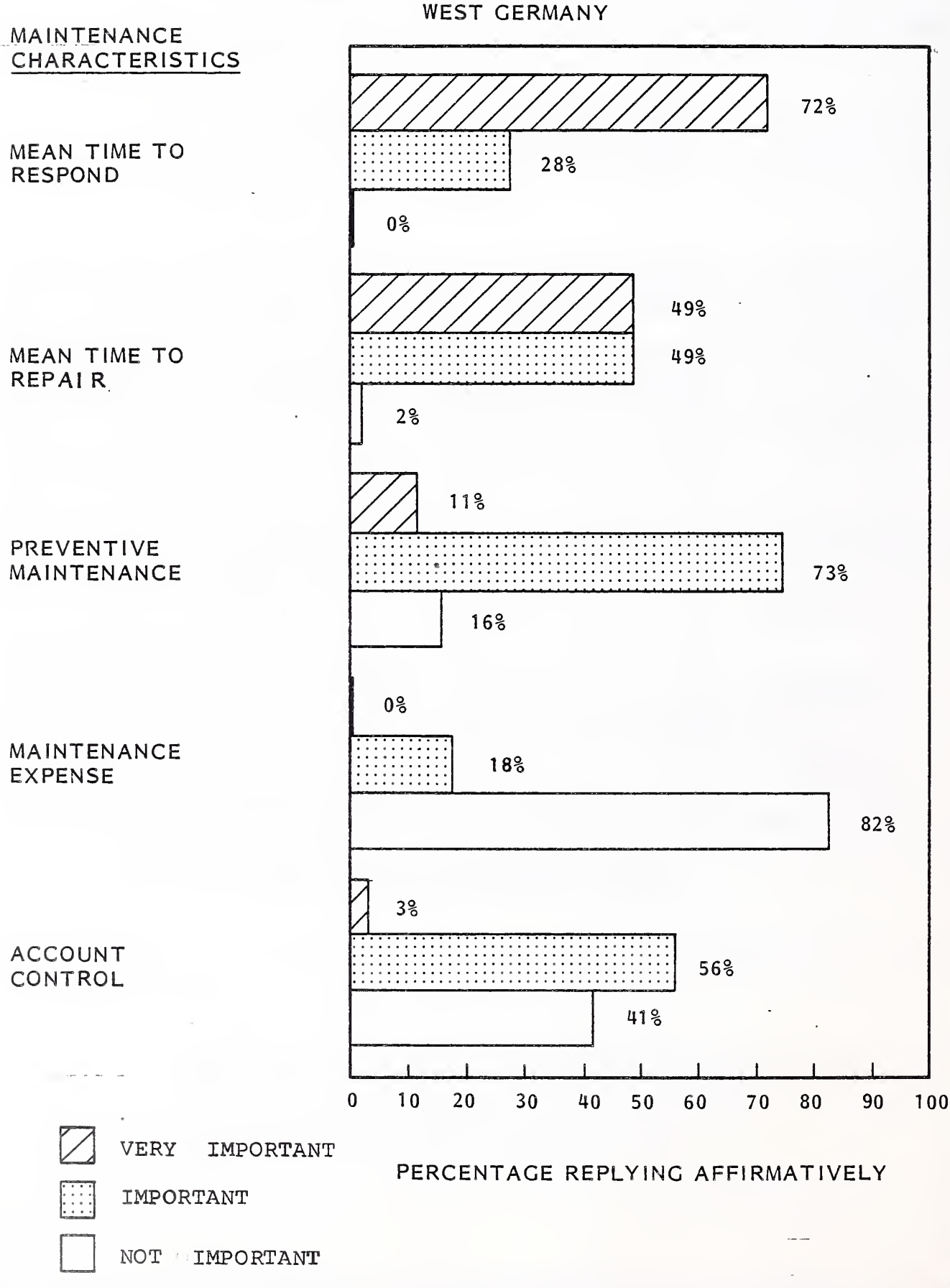

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EXHIBIT IV-17

RESPONDENT USERS' RATING OF THE

IMPORTANCE OF FIELD MAINTENANCE CHARACTERISTICS

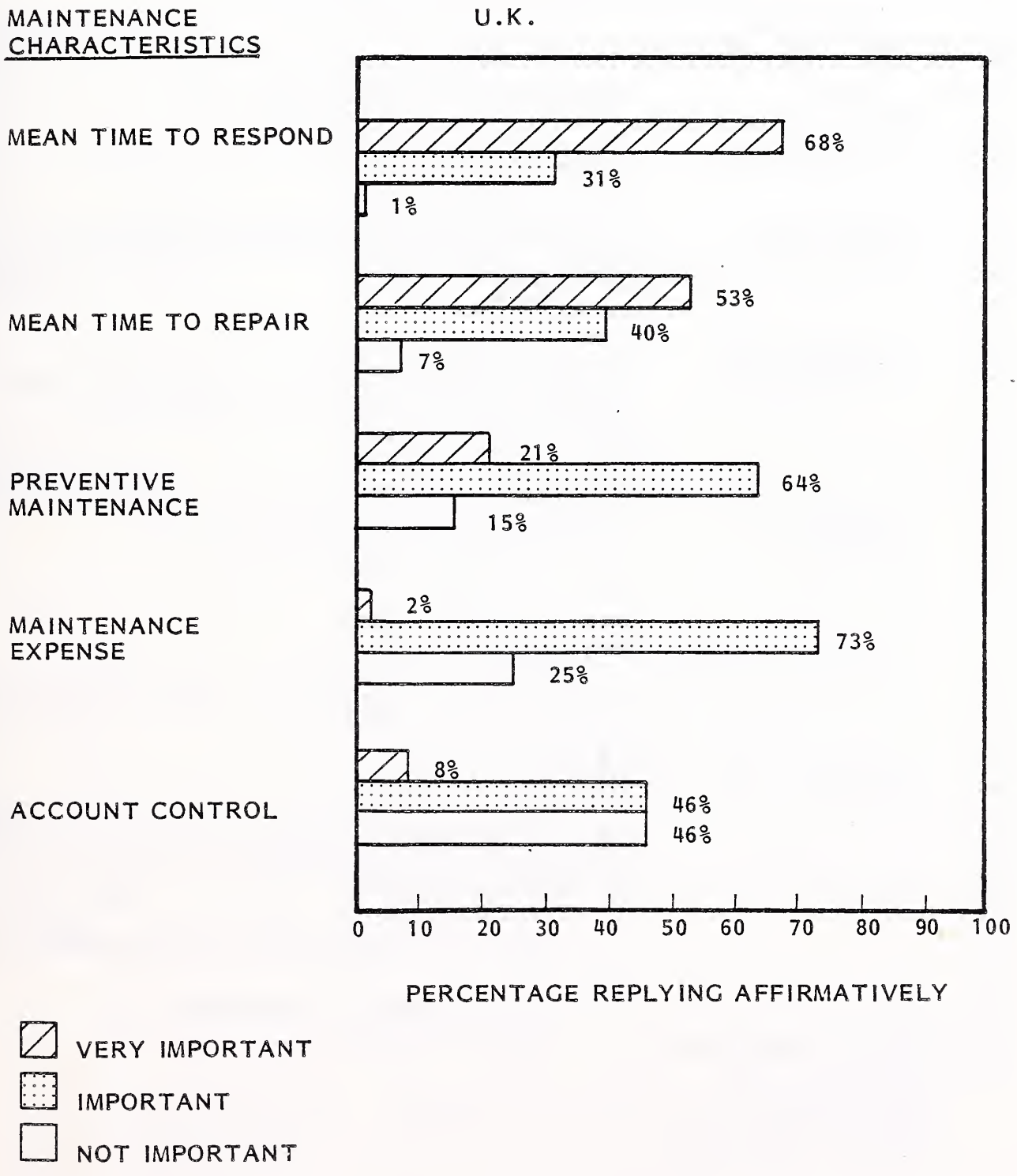

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EXHIBIT IV-18

RESPONDENT USERS RATING OF THE IMPORTANCE
OF FIELD MAINTENANCE CHARACTERISTICS
HOLLAND

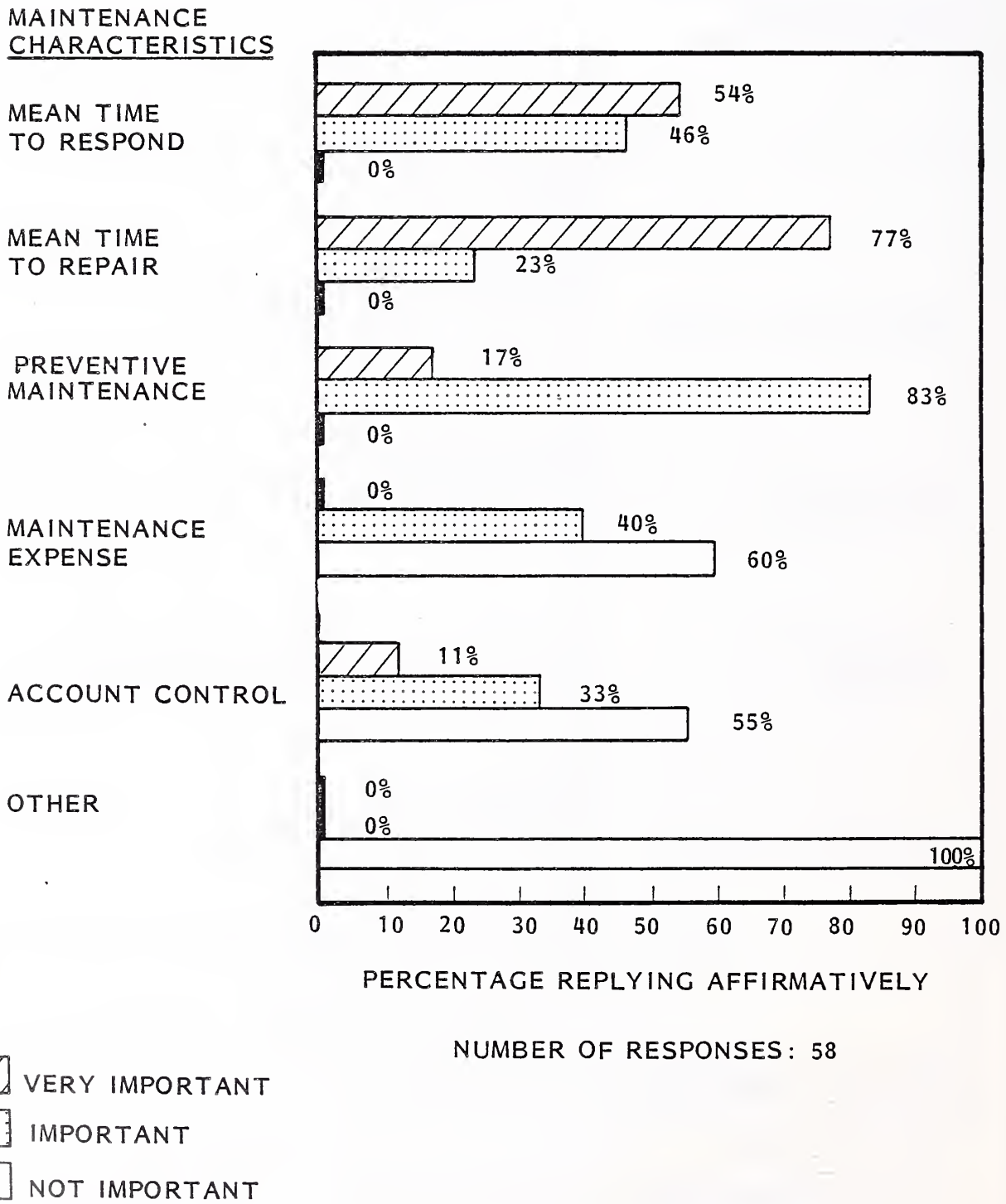

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EXHIBIT IV-19

RESPONDENT USERS' RATING OF THE IMPORTANCE OF FIELD MAINTENANCE CHARACTERISTICS
FRANCE

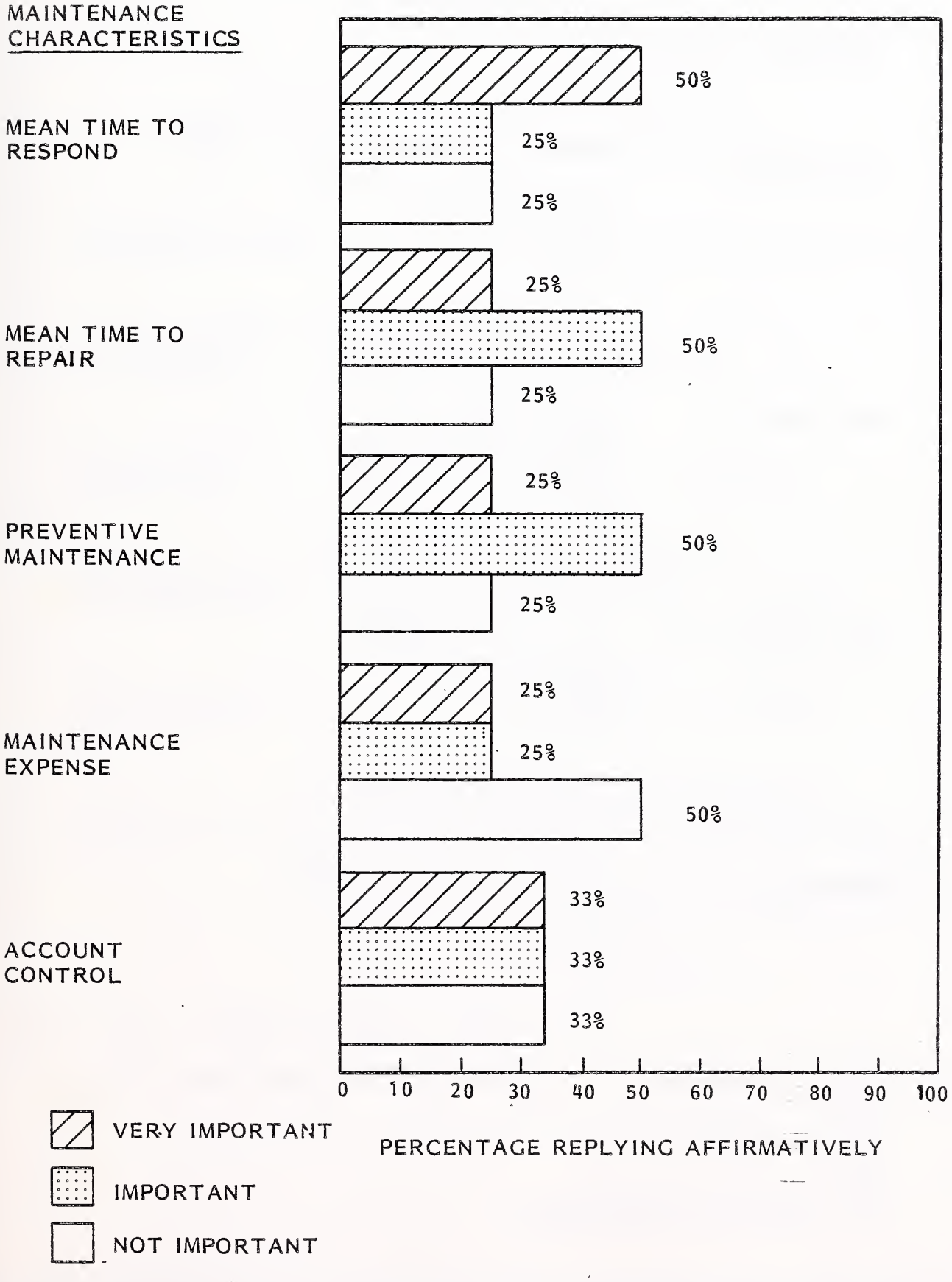

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EXHIBIT IV-20

RESPONDENT USER'S SATISFACTION/DISSATISFACTION WITH MEAN TIME TO RESPOND
EUROPE

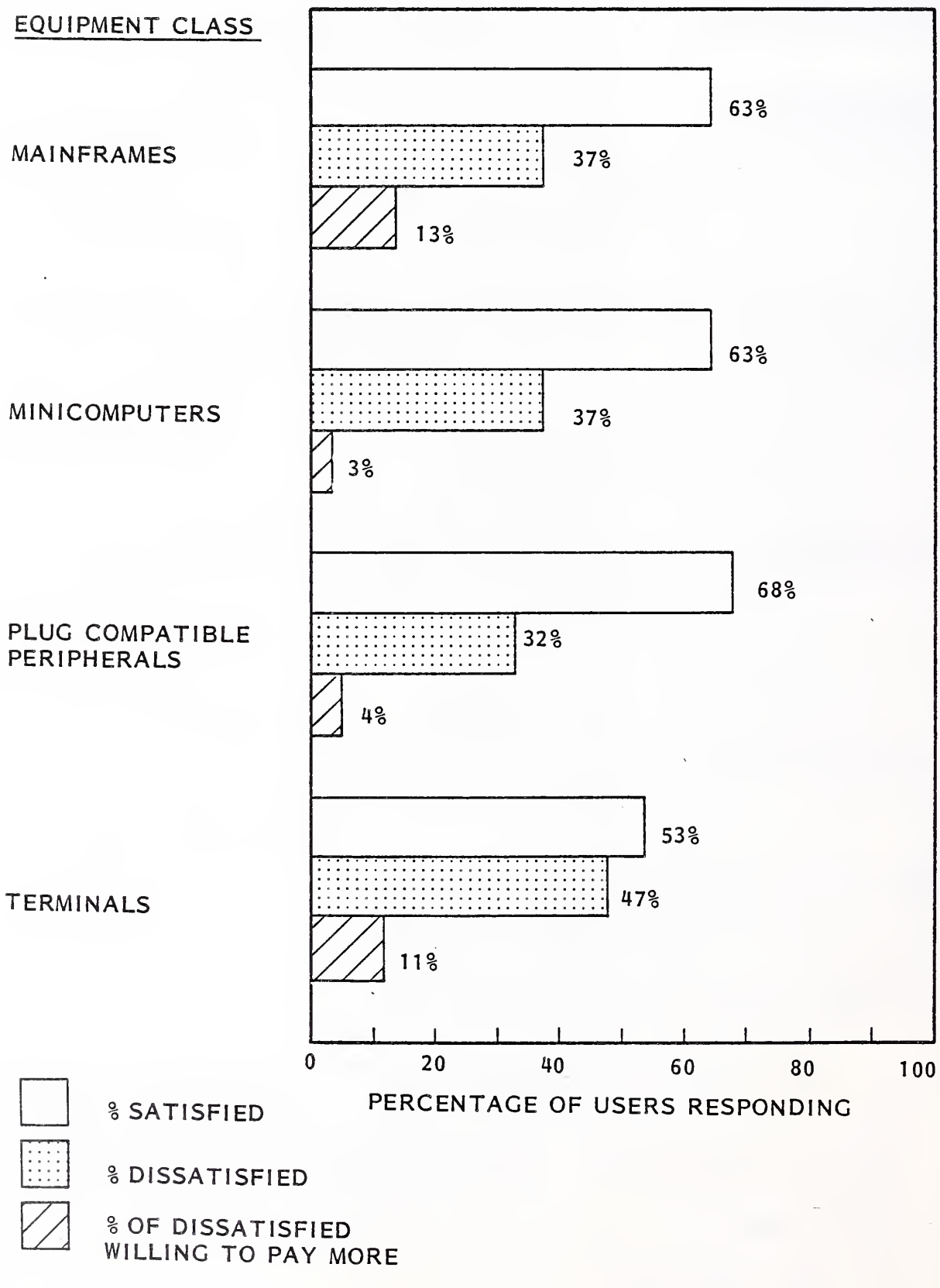

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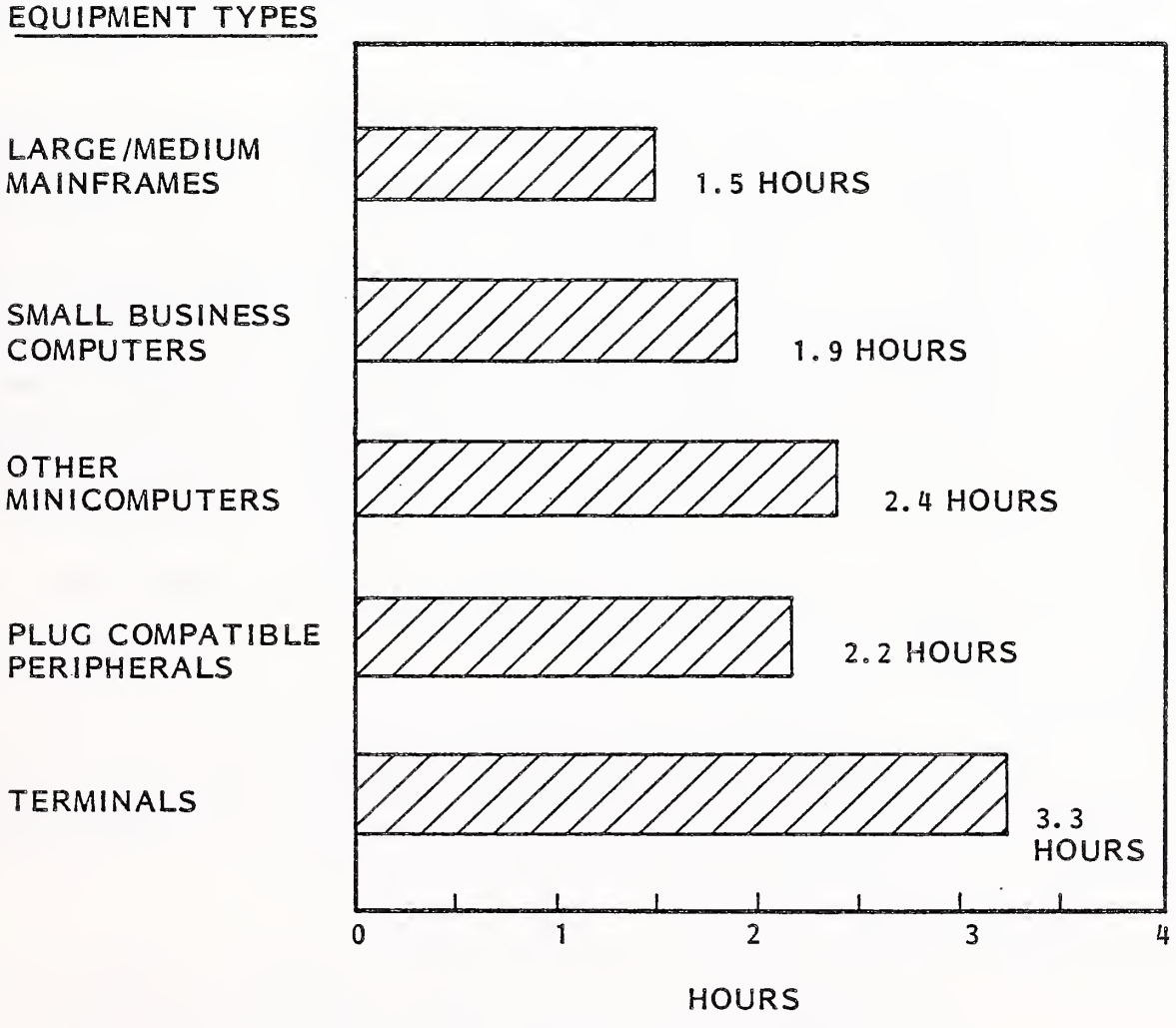
EXHIBIT IV-21

RESPONDENT USERS MINIMUM ACCEPTABLE
MEAN TIME TO RESPOND BY CLASS OF EQUIPMENT

EUROPE



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- minicomputers, where a similar proportion (37%) are dissatisfied with response time but where only 10% are prepared to pay more for improved performance:

- plug compatible periherals, where an almost identical situation to that of the minicomputers pertains,

- terminals, where nearly half of the users are dissatisfied, 23% of whom would be prepared to pay more.

- The maximum delay that is found acceptable, by type of equipment (on average across the contries examined) is shown in Exhibit IV-21. Business oriented computers, whether large, medium or small need to be attended to within 2 hours of a fault occuring. Minicomputers and plug compatible peripherals are allowed slightly more time and terminals nearly a third more than any other category. (This is most probably due to the fact that the users interviewed were mainly large enterprises where the terminal configurations are large, and where the loss of a terminal is not immediately critical).

- The country differences on this point are significant, (see Exhibits IV-22 to IV-25):

  - in the UK the most stringent requirement is for large systems; a second category of equipment groups together small business and minicomputers, while plug compatible peripherals and terminals are in a class of their own, as non-critical equipment,

  - in West Germany, small business computers are expected to be cared for in less than 1 hour and all other equipment under 2 hours,

  - in France, all business computer failures must be responded to within 2 hours, minis and plug compatible peripherals within 3 hours, and terminals can be serviced in 5 hours,

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EXHIBIT IV-22

RESPONDENT USERS MINIMUM ACCEPTABLE
MEAN TIME TO RESPOND BY CLASS OF EQUIPMENT

U.K.

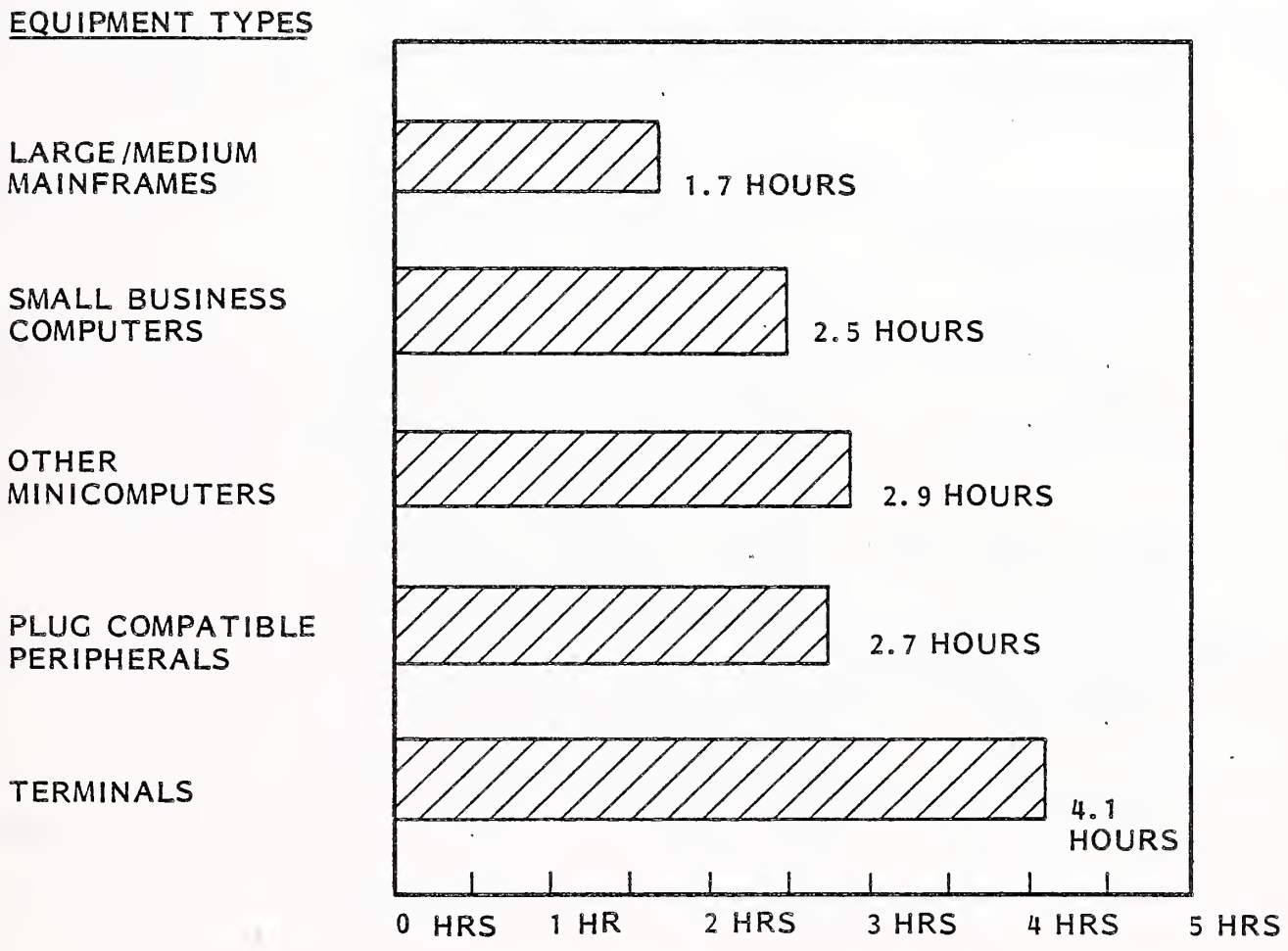

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EXHIBIT IV-23

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME TO RESPOND BY CLASS OF EQUIPMENT

WEST GERMANY

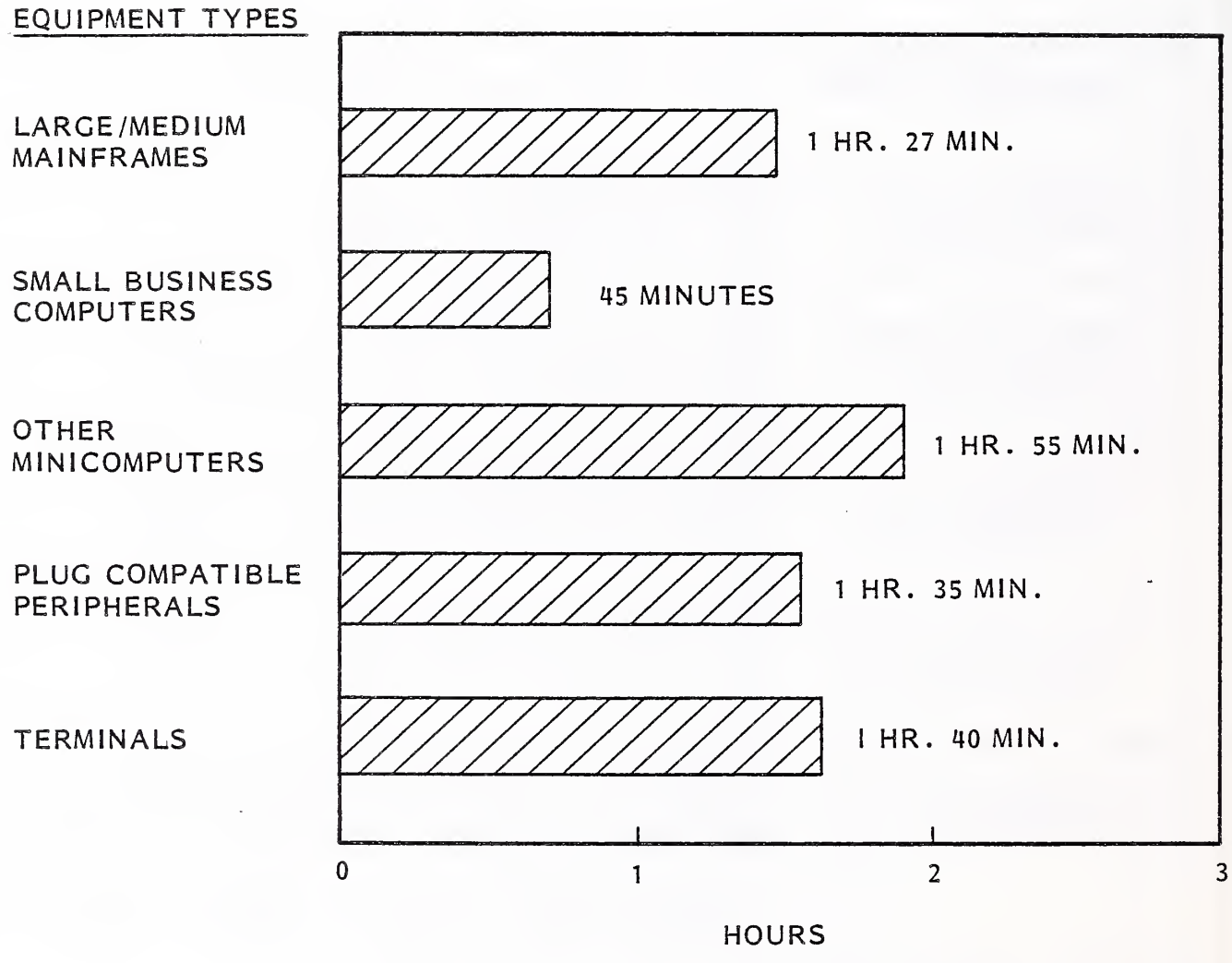

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EXHIBIT IV-24

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME TO RESPOND BY CLASS OF EQUIPMENT

FRANCE

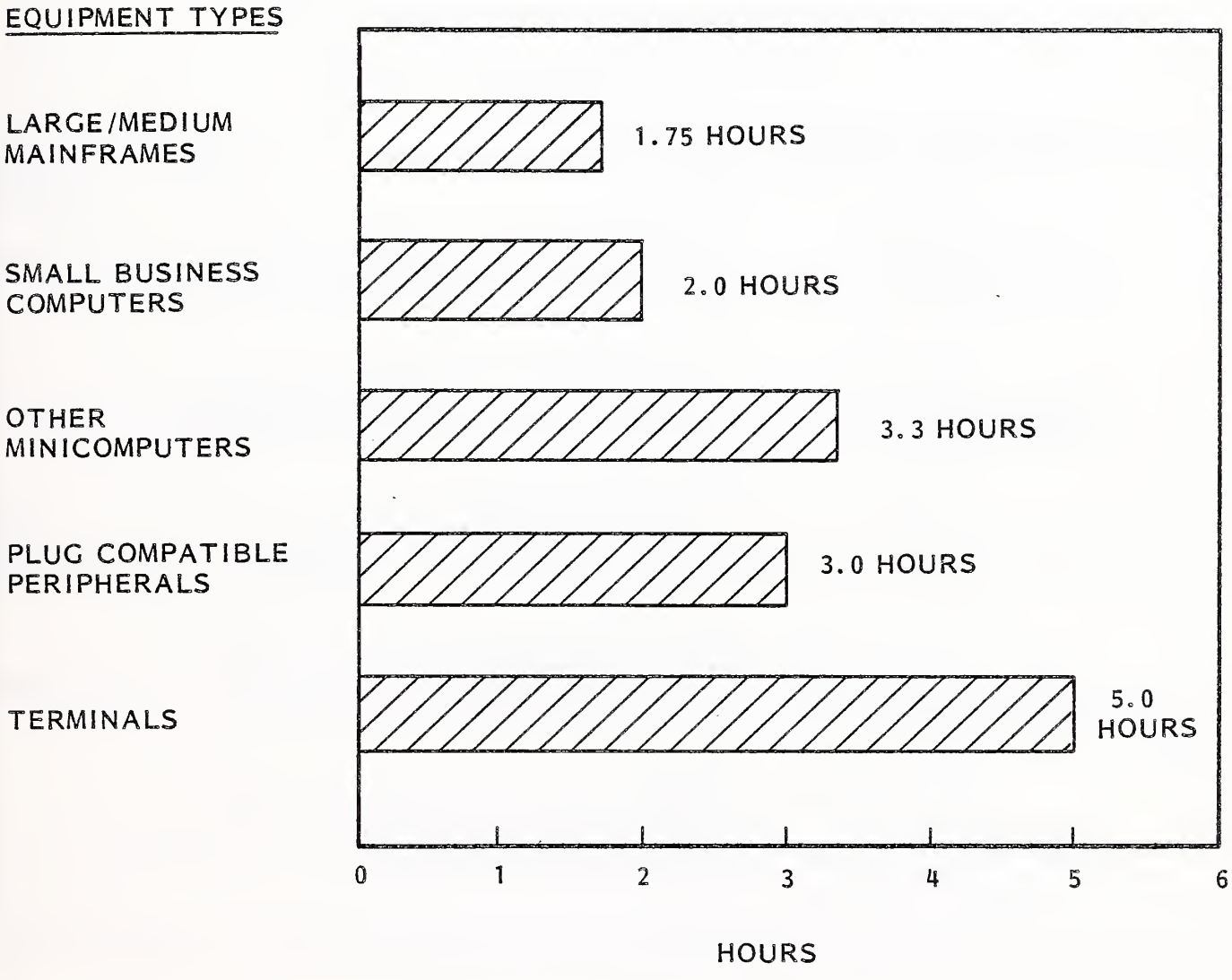

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EXHIBIT IV-25

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME TO RESPOND BY CLASS OF EQUIPMENT
HOLLAND

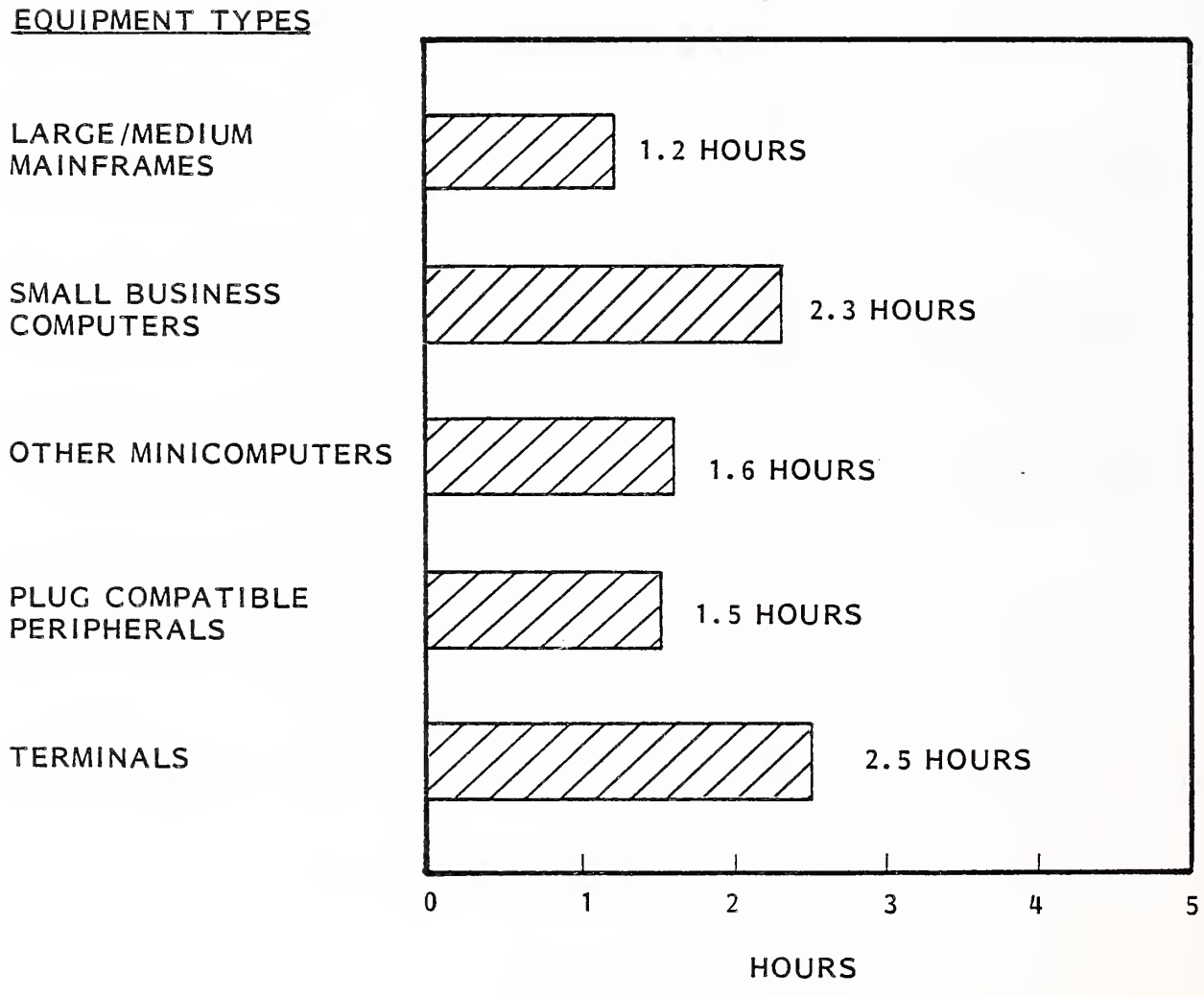

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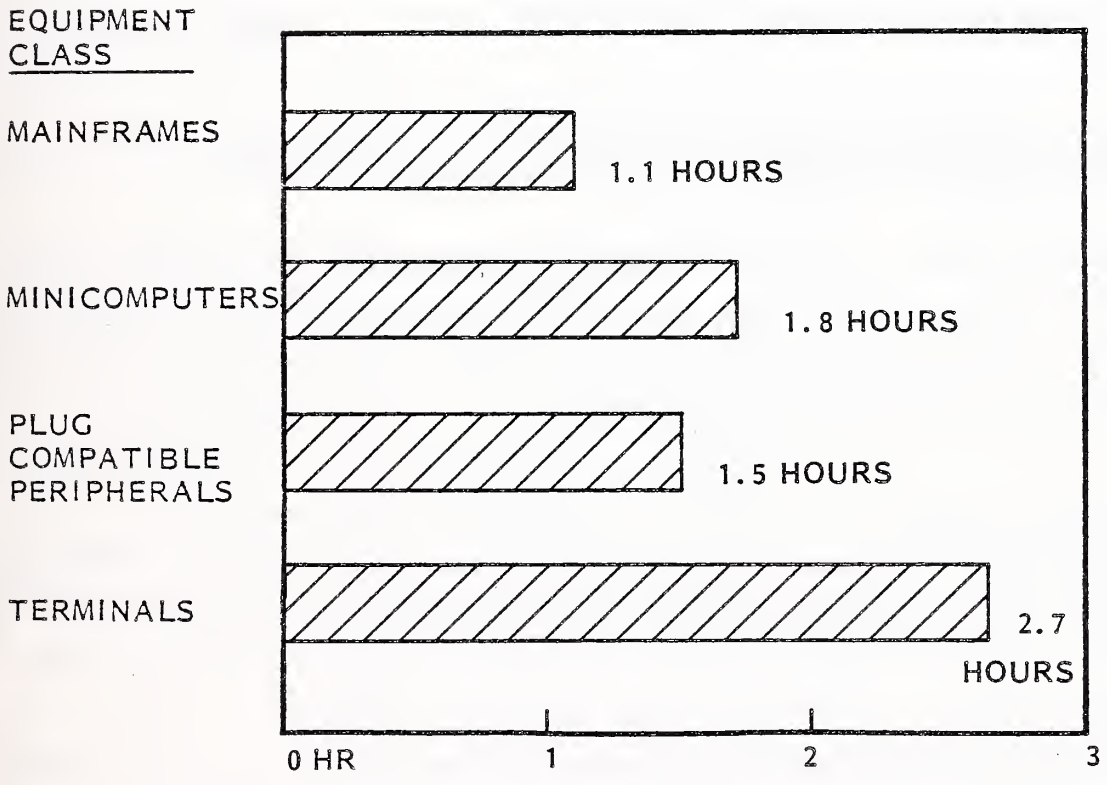
EXHIBIT IV-26

DESIRED AVERAGE RESPONSE TIME OF
DISSATISFIED RESPONDENT USERS
EUROPE



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- in Holland there are only two categories of equipment; that which must be attended to within 1.2 to 1.6 hours and that which should be serviced within two and a half hours.

- In terms of the desired average response time, (by dissatisfied users only), users are looking for improvements of the order of 30%. Exhibit IV-26 details the actual response times that are sought, by class of equipment.

- Exhibit IV-27 summarizes the percentage increase each class of users are prepared to pay for improved response time.

D. MEAN TIME TO REPAIR: EVALUATION OF REQUIREMENTS

- The second most important maintenance characteristic for end user is mean time to repair. Exhibit IV-28 identifies the relative satisfaction of respondent users with this aspect of the maintenance service they are currently receiving, for each of the main equipment categories.

- There is a significant measure of dissatisfaction with repair time with 34% - 42% finding current service inadequate. One third of the users of mainframes that are dissatisfied are prepared to pay more for a better source but for all other categories of equipment users are generally not prepared to pay more.

- The minimum acceptable repair time is almost independent of the type of equipment (see Exhibit IV-29) and varies only slightly from 3.3 to 4.6 hours. These must be seen as the longest period users, on average, are willing to put up with.

- On a country basis there is significant divergence from these average values:

  - in the U.K., (see Exhibit IV-30) end users are far more congenial than elsewhere; a repair within 7-8 hours is the maximum acceptable for small business and minicomputer system users, and for plug compatible peripheral users; (in reality they do not have to wait more than 2-3 hours on average, according to U.K. vendors),

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EXHIBIT IV-27

AVERAGE ADDITIONAL PERCENTAGE RESPONDENT
USERS WOULD BE WILLING TO PAY FOR
IMPROVED RESPONSE TIME

EUROPE

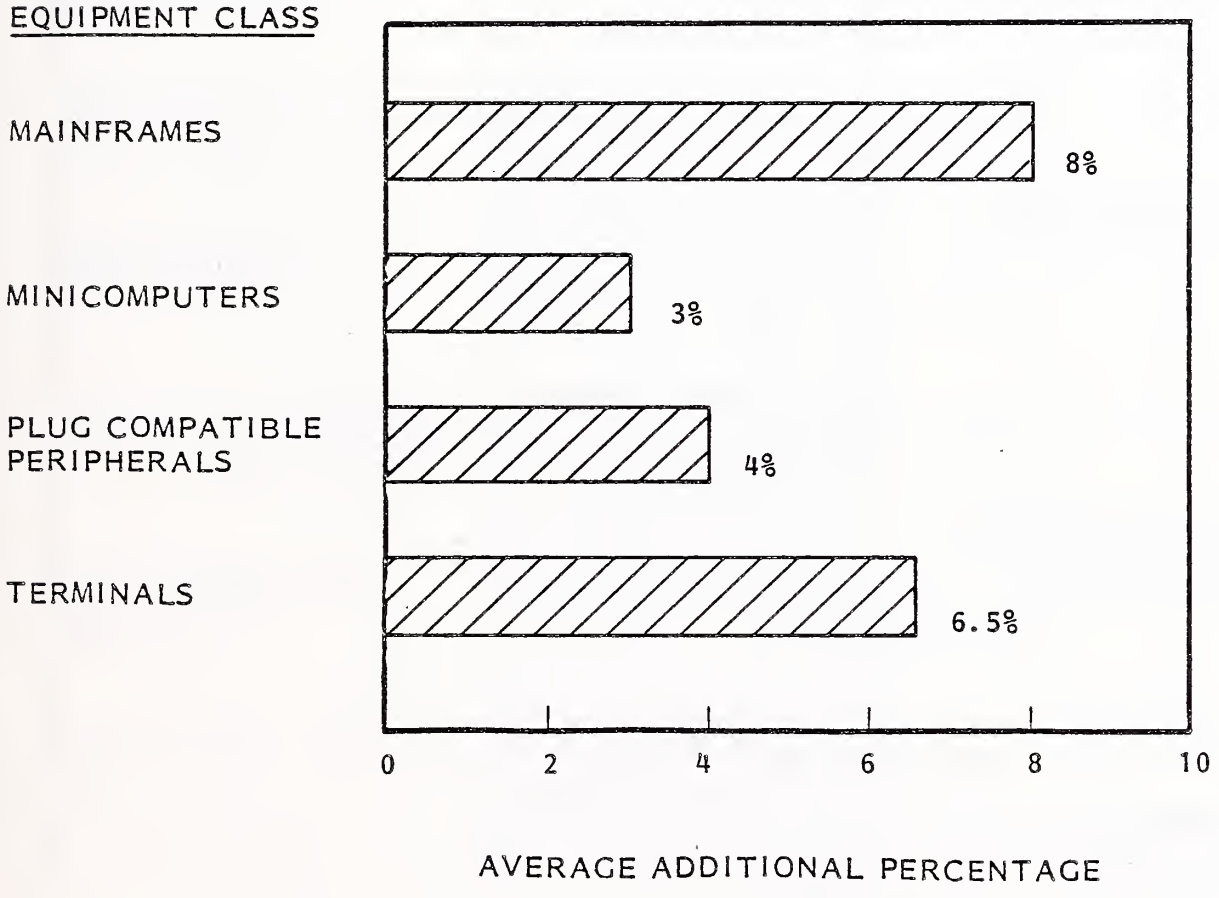

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EXHIBIT IV-28

RESPONDENT USERS' SATISFACTION/DISSATISFACTION
WITH MEAN TIME TO REPAIR

EUROPE

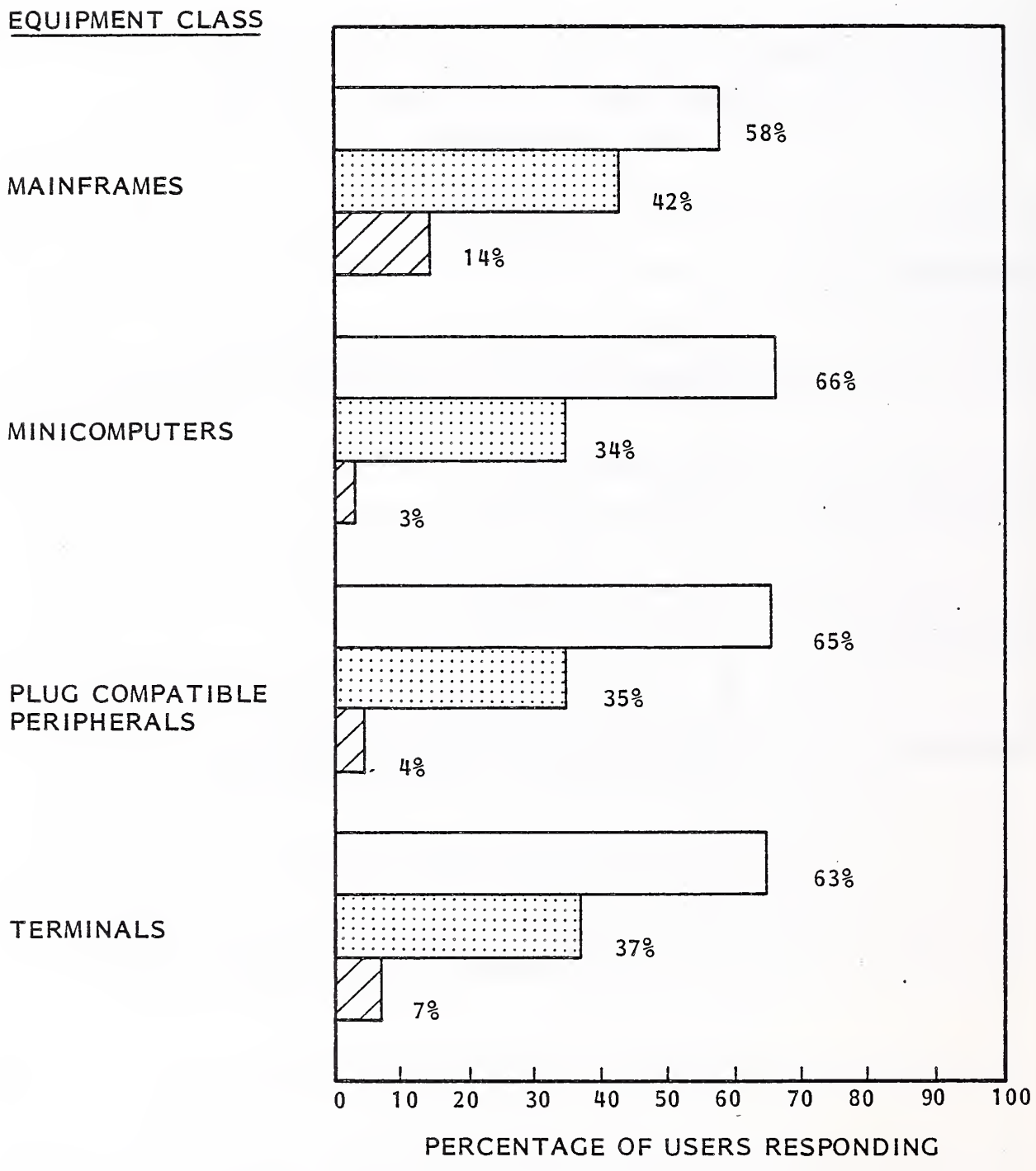

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EXHIBIT IV-29

RESPONDENT USERS' MINIMUM ACCEPTABLE MEAN TIME
TO REPAIR BY CLASS OF EQUIPMENT
EUROPE

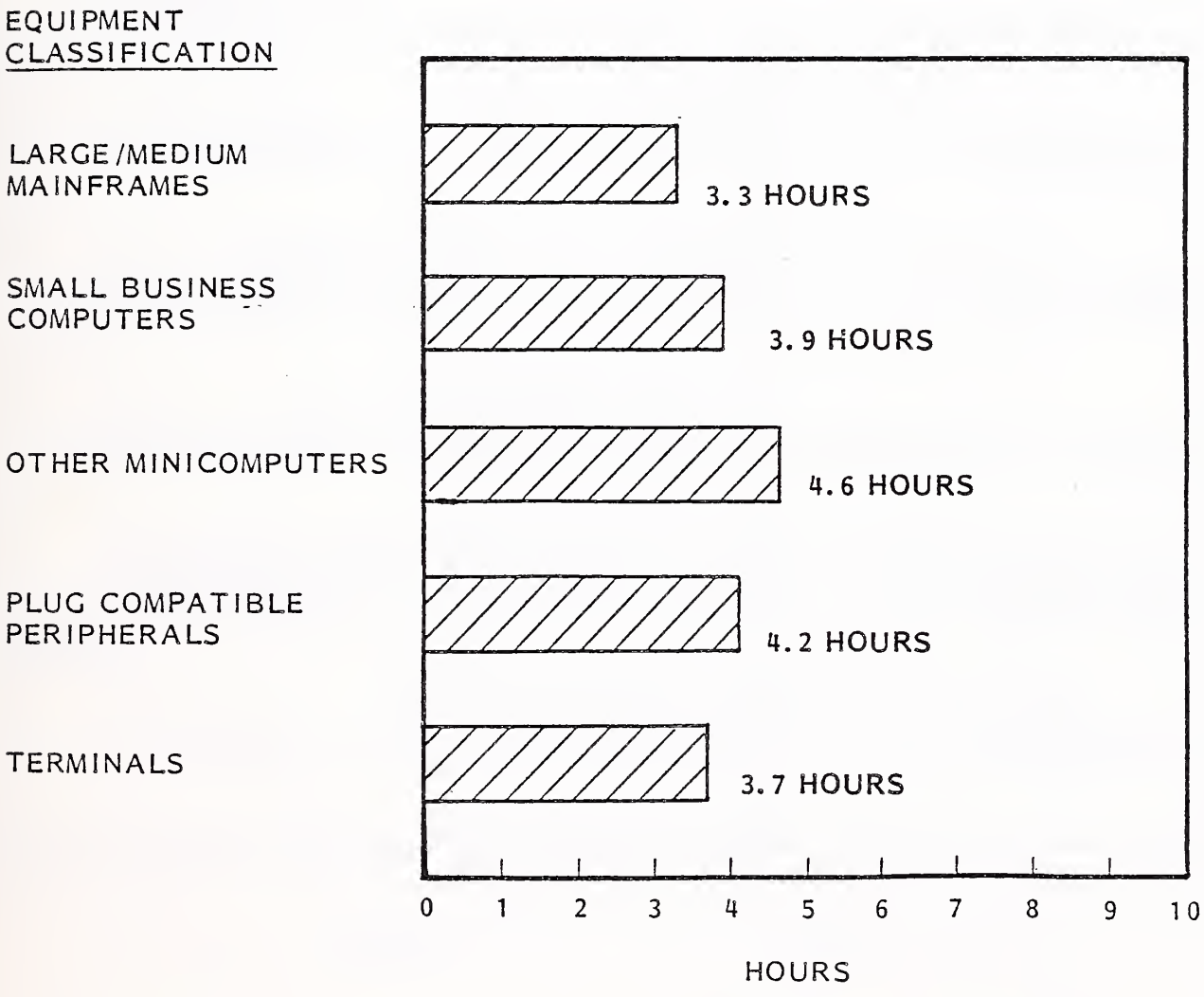

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EXHIBIT IV-30

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME TO REPAIR BY CLASS OF EQUIPMENT

U.K.

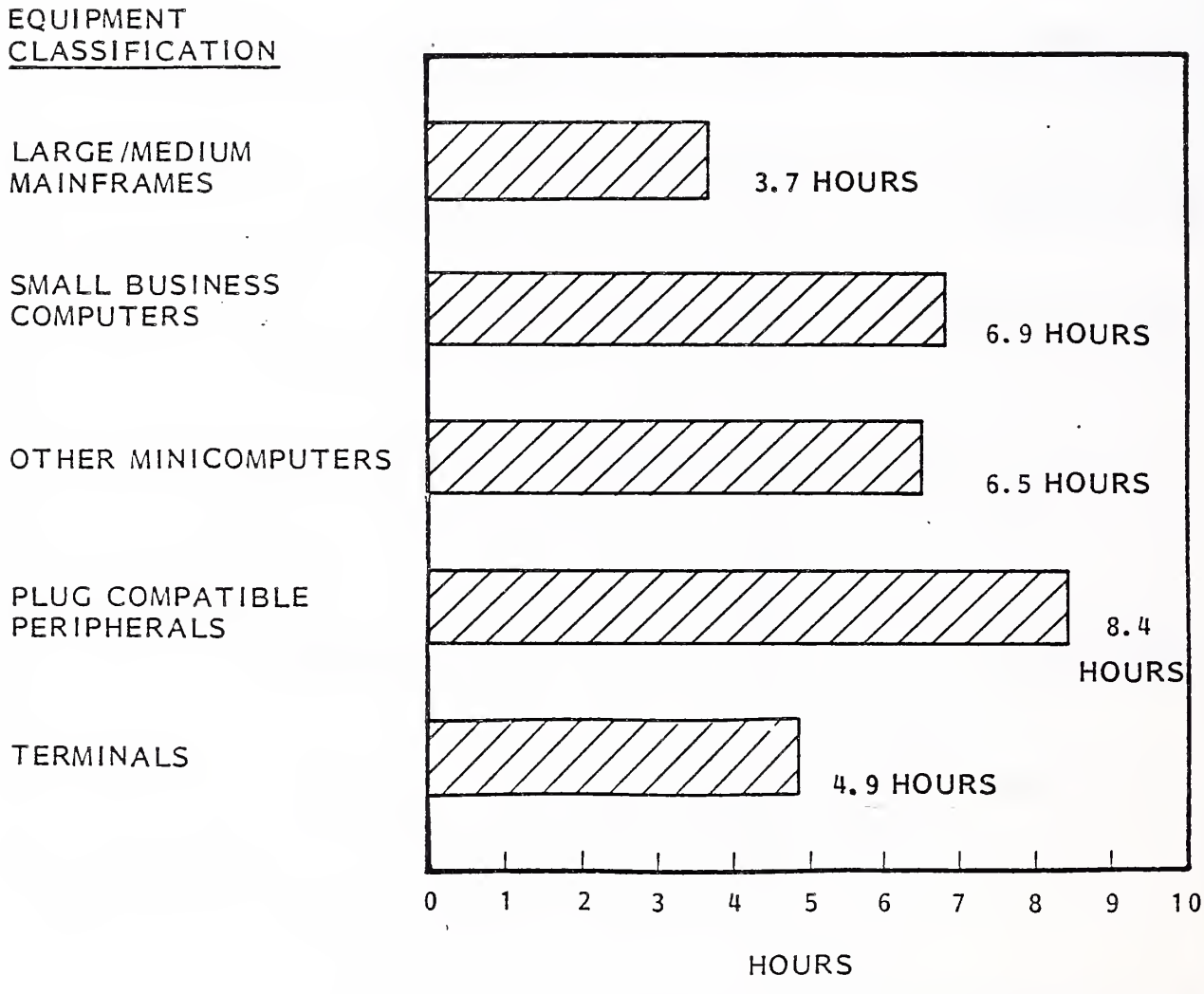

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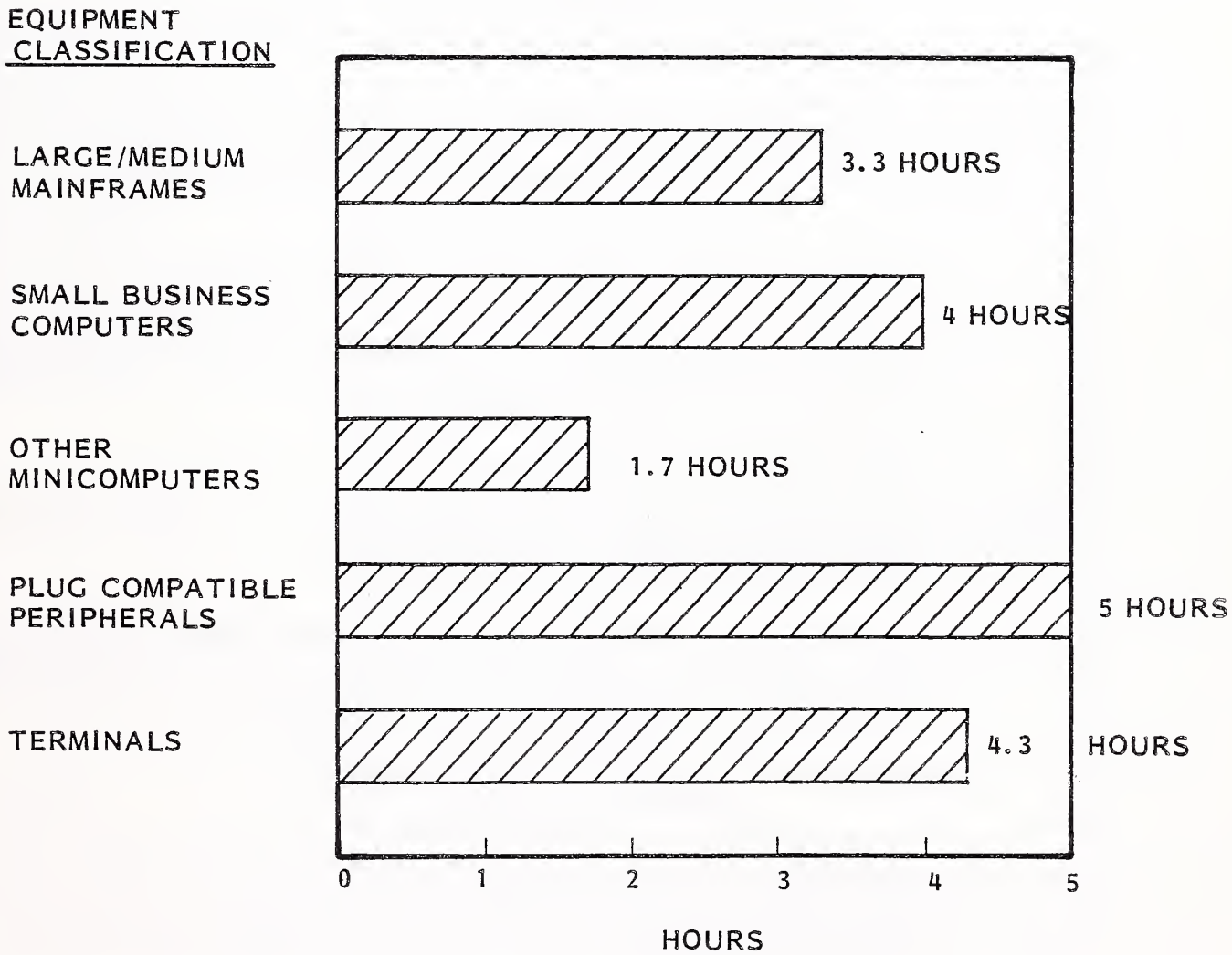
EXHIBIT IV-31

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME TO REPAIR BY CLASS OF EQUIPMENT
HOLLAND



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- in Holland (see Exhibit IV-31) the picture is already one of tighter requirements; the maximum is 5 hours and for certain equipment (minicompiuters) a stringent 1.7 hours is expected,

- in West Germany (see Exhibit IV-32) the overall requirements are down to 1.5 to 3.5 hours, but for minicomputers a maximum of 7-6 hours is considered reasonable; (note that this does not mean that users would be willing to put up with this level of service on an on-going basis),

- in France, the maximum acceptable repair time is down to a very tight 2-3 hours across all categories of equipment (see Exhibit IV-33).

- In order to improve on the repair time they are currently subjected to, users are willing to pay marginally more than today's rates (see Exhibit IV-34). The percentage increase in cost that should be acceptable varies from 3% to 7% according to the category of equipment.

E. DISRUPTIVE DEVICES: USERS PERCEPTION

- Exhibit IV-35 shows the list of devices that users perceive are most frequently out of service. This does not mean that these are, on a measured basis, the most frequently deffective devices, but merely those that come to the users attention, because of the function they perform.

- Thus when the console is down, the entire system is seriously inconvenienced and the user is immediately aware of its inactivity. In a similar way the CPU and disk drives are obviously very sensitive components of the system.

- Visual display units (VDUs) are not seen as being frequently out of service: this may mean that when they are down, they do not have, individually, a great impact on the system.

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EXHIBIT IV-32

RESPONDENT USERS' MINIMUM ACCEPTABLE MEAN TIME
TO REPAIR BY CLASS OF EQUIPMENT

WEST GERMANY

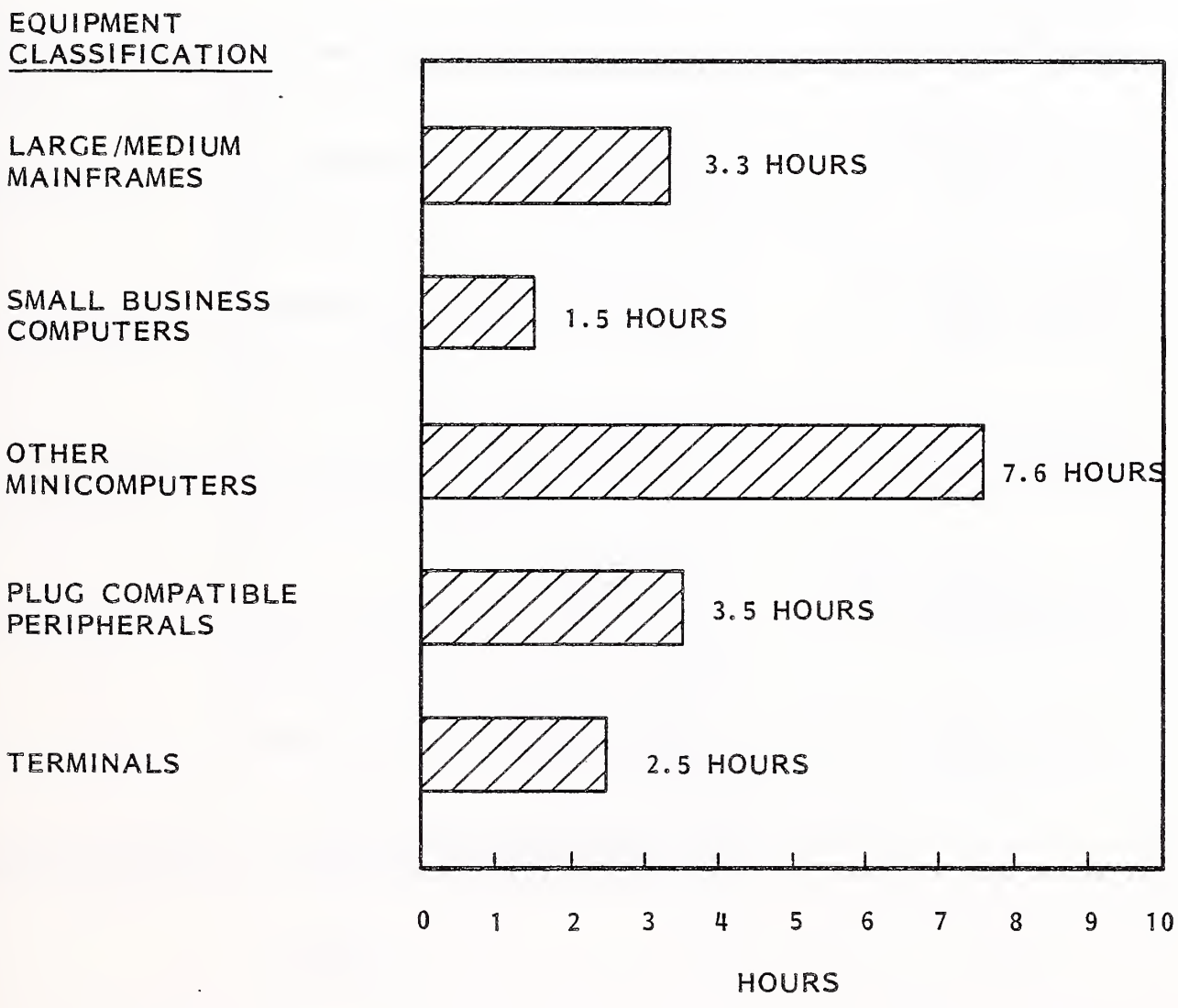

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EXHIBIT IV-33

RESPONDENT USERS' MINIMUM ACCEPTABLE MEAN TIME TO REPAIR BY CLASS OF EQUIPMENT

FRANCE

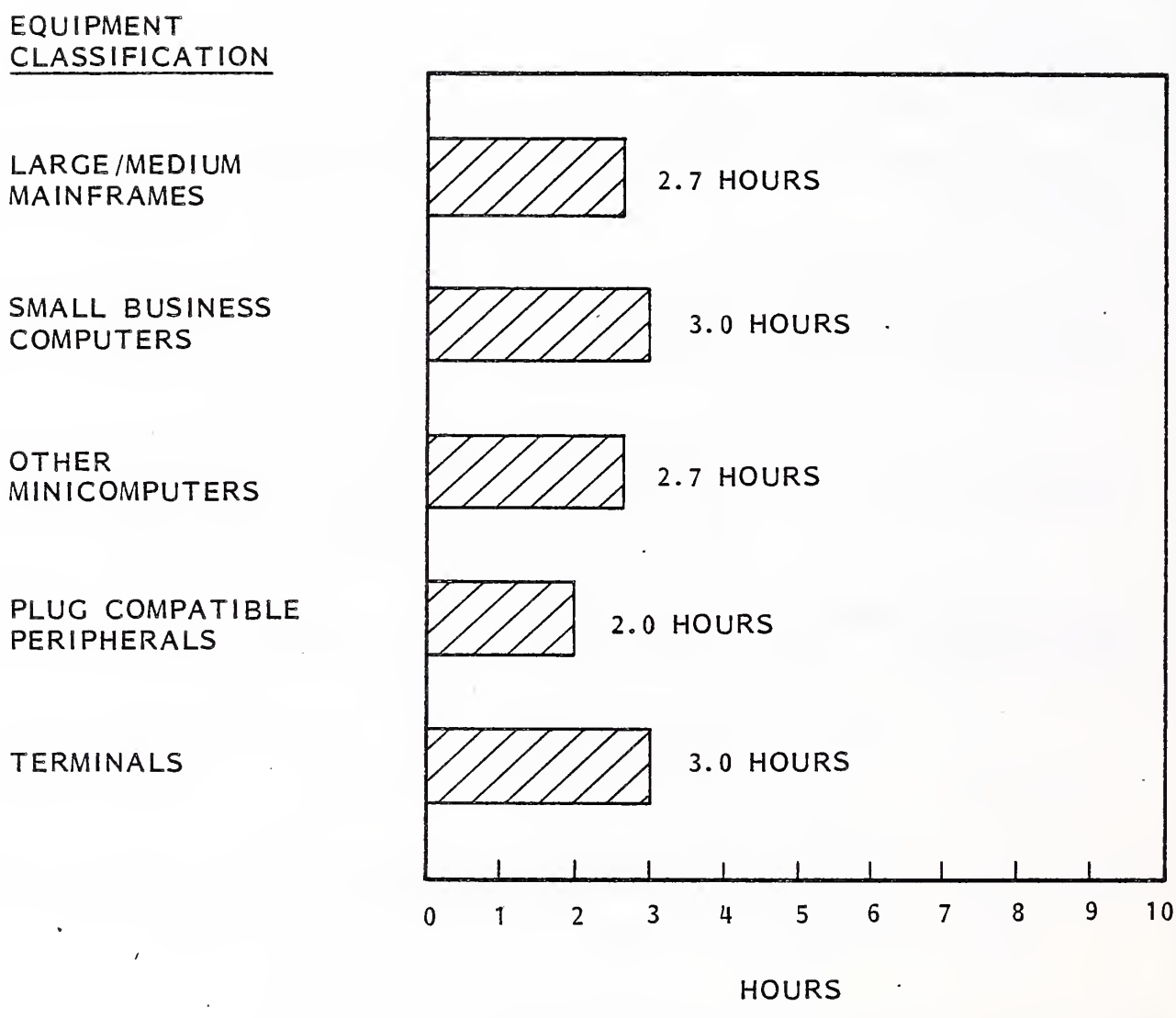

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EXHIBIT IV-34

AVERAGE ADDITIONAL PERCENTAGE RESPONDENT
USERS WOULD BE WILLING TO PAY FOR
IMPROVED REPAIR TIME

EUROPE

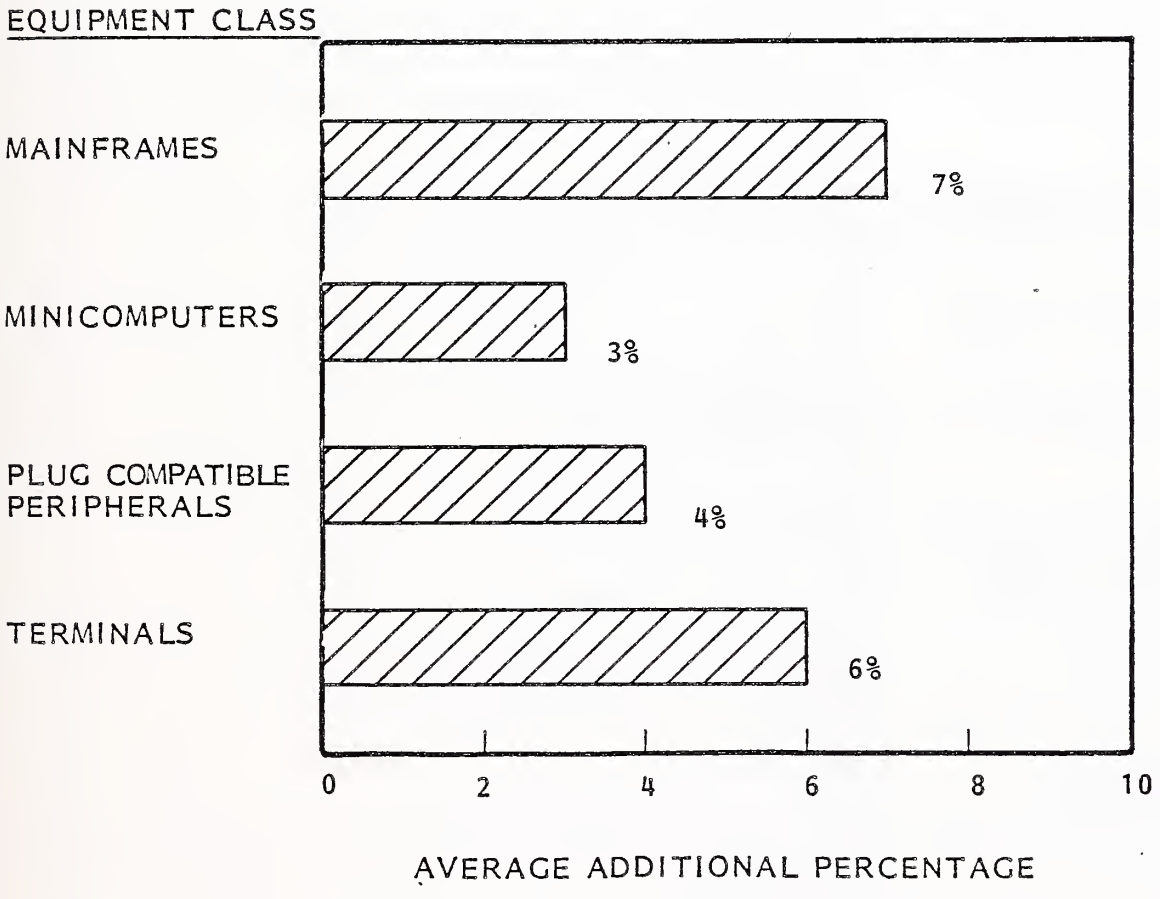

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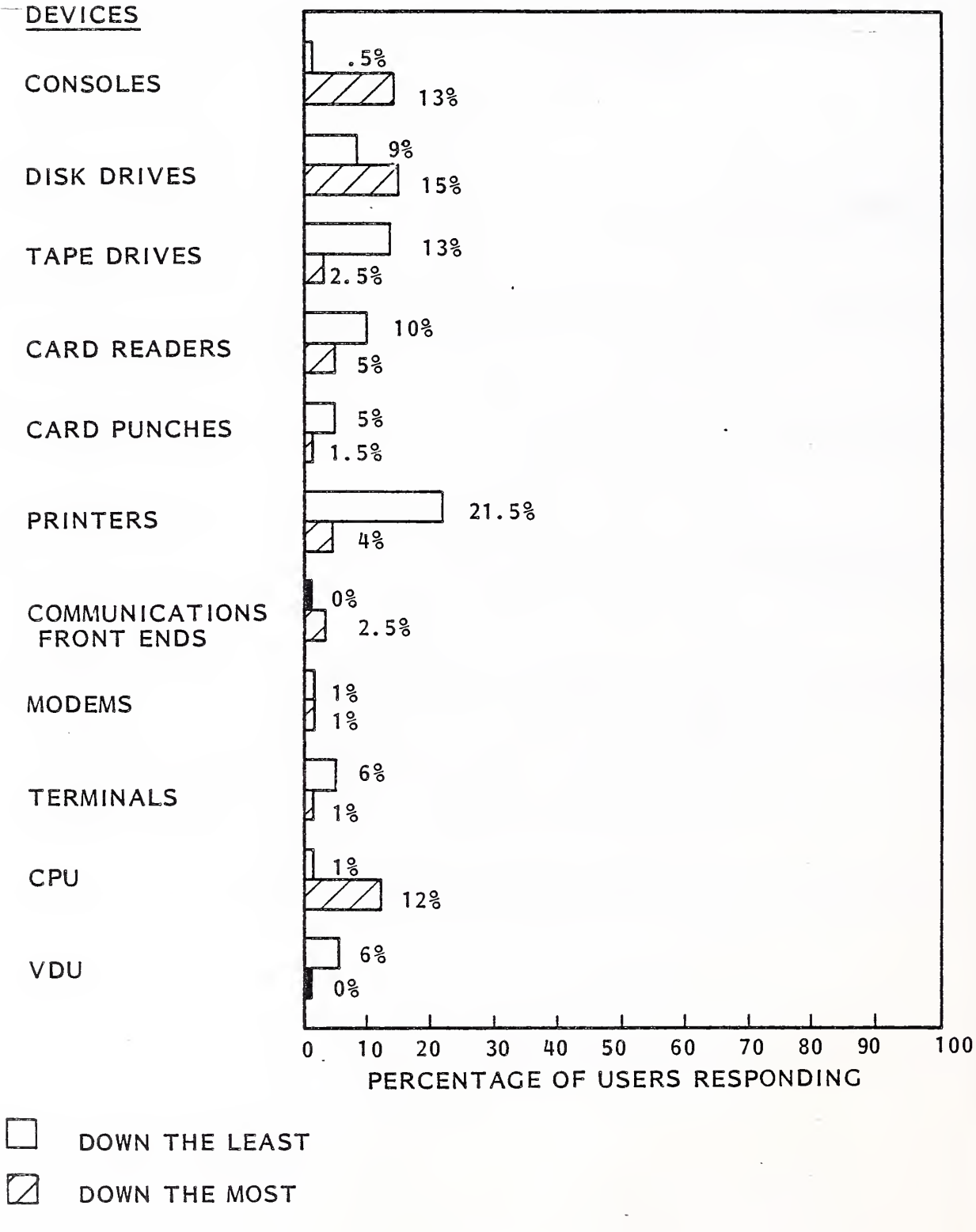
EXHIBIT IV-35

RESPONDENT USERS' PERCEPTIONS OF THE
DEVICES OUT OF SERVICE THE MOST AND THE LEAST
EUROPE



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- Conversely, those devices which are visibly providing a heavy work output are expected to have some failures and are judged accordingly: the average printer's MTBF is not very high, but, since it is seen to be working all the time, the user expects a certain amount of failure.

- The most disruptive devices, when down, are examined in Exhibit IV-36 which clearly identifies the key elements of the average configuration. Further Exhibits by size of user are given in IV-37 to IV-40; the results show significant variance and the reader can almost re-construct an average configuration by size of user, from the devices that are seen to be crucial.

- Exhibit IV-37 is an example of this:

  - nearly all very large users make heavy use of communications whether by front end, terminal or modem; as a result all three show as causing disruption when down,

  - many configurations have more than one printer; when a printer is out, it causes some disruption but is not crucial,

  - card punches are hardly ever used and are frequently absent from the configuration altogether,

  - disk drives and consoles have significant impact, but a single tape unit failure has minor repercussions.

- Large users (Exhibit IV-38) have similar but different priorities:

  - terminals and modems, when down, have less impact but the front end is still very important,
  - all disk drives are important and a failure of one unit is significant,
  - the (usually single) console is also important and can disrupt the entire system when out of commission,

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EXHIBIT IV-36

RESPONDENT USERS' RANKING OF THE MOST DISRUPTIVE DEVICES WHEN OUT OF SERVICE
EUROPE

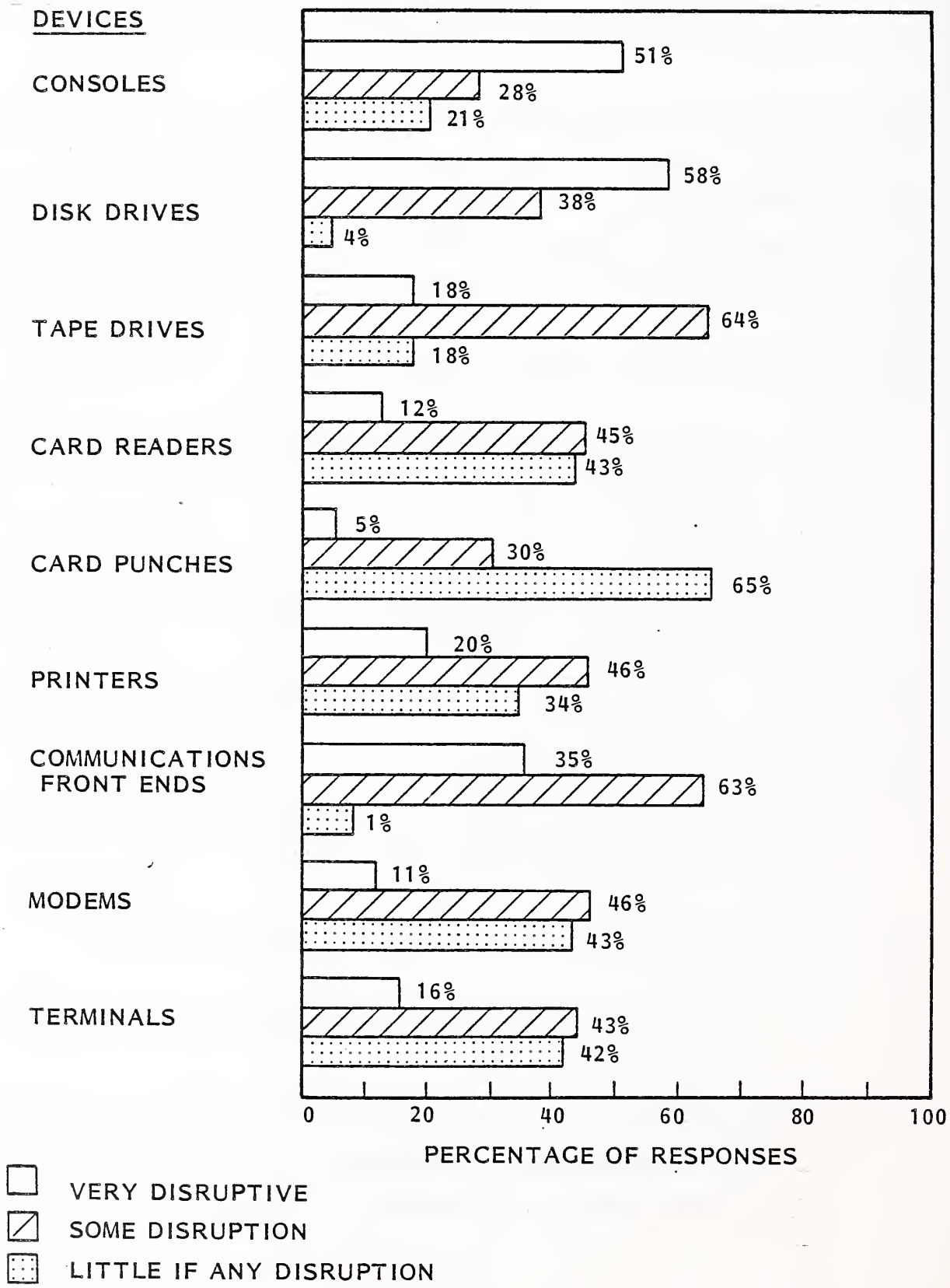

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EXHIBIT IV-37

VERY LARGE SIZE RESPONDENT USER RANKING OF THE MOST DISRUPTIVE DEVICES WHEN OUT OF SERVICE EUROPE

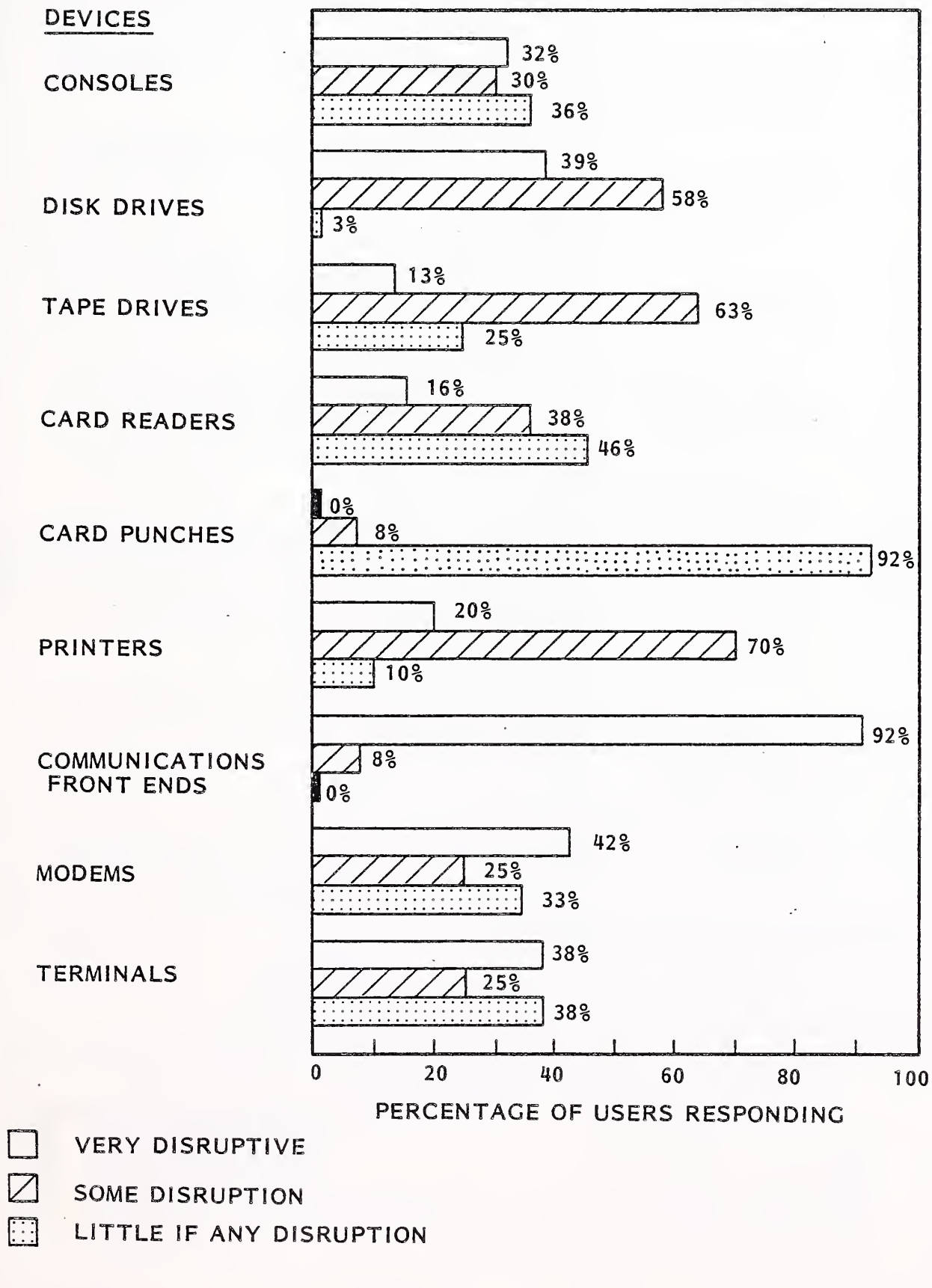

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EXHIBIT IV-38

LARGE SIZE RESPONDENT USERS' RANKING OF THE MOST DISRUPTIVE DEVICES WHEN OUT OF SERVICE
EUROPE

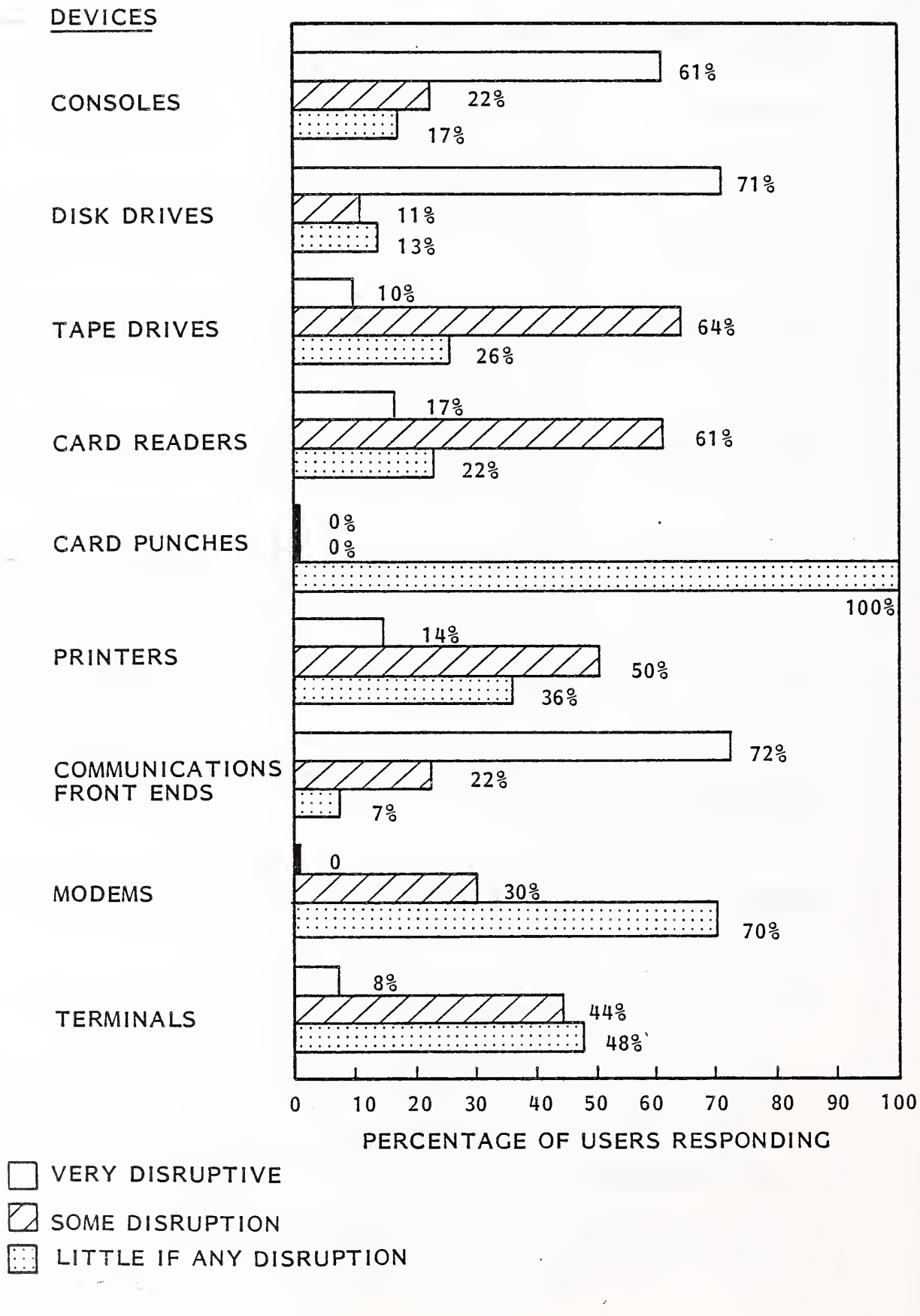

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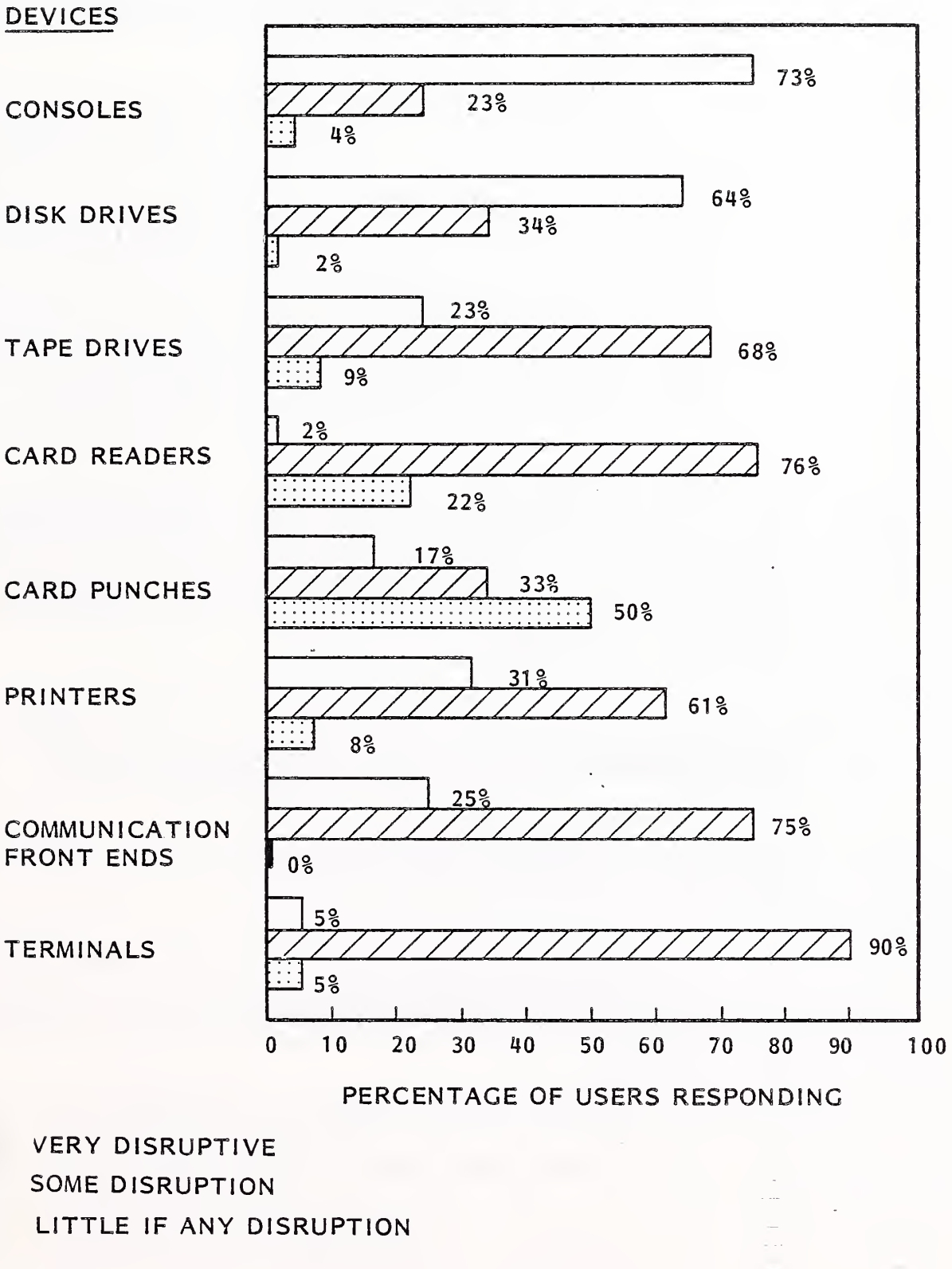
EXHIBIT IV-39

MEDIUM SIZE RESPONDENT USER RANKING OF
THE MOST DISRUPTIVE DEVICES WHEN OUT OF SERVICE
EUROPE



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- tape drives and card readers begin to take on slightly more importance but card punches are systematically absent,
- printers are still used in multiples and can individually fail without too much impact.

- Medium-sized users (Exhibit IV-39) have a different mix of crucial devices:
  - card readers suddenly begin to be significant and card punches reappear,
  - communications front ends decrease in importance, as do terminals,
  - printers and tape drives are very important, and, as the number of disk drives decreases so their individual importance increases,
  - console are still very important since there is usually only one.

- Small size users (Exhibit IV-40) do not always have communications and are frequently without terminals. The mix of devices found on configurations used are very varied, but more and more systems can operate without the use of the card reader or card punch.

F. USER REQUIREMENTS FOR MEAN TIME BETWEEN FAILURE

- Acceptable limits of mean time between failure are fairly narrowly defined in the minds of end users, (see Exhibit IV-41):
  - they do not accept failures of the order of one a week,
  - a high proportion (38%) see an MTBF of the order of one month as the minimum,
  - an even higher proportion (42%) require an MTBF of over a month,
  - a very small percentage expect or require more than six months.

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EXHIBIT IV-40

EUROPE

SMALL SIZE RESPONDENT USER RANKING OF THE MOST DISRUPTIVE DEVICES WHEN OUT OF SERVICE

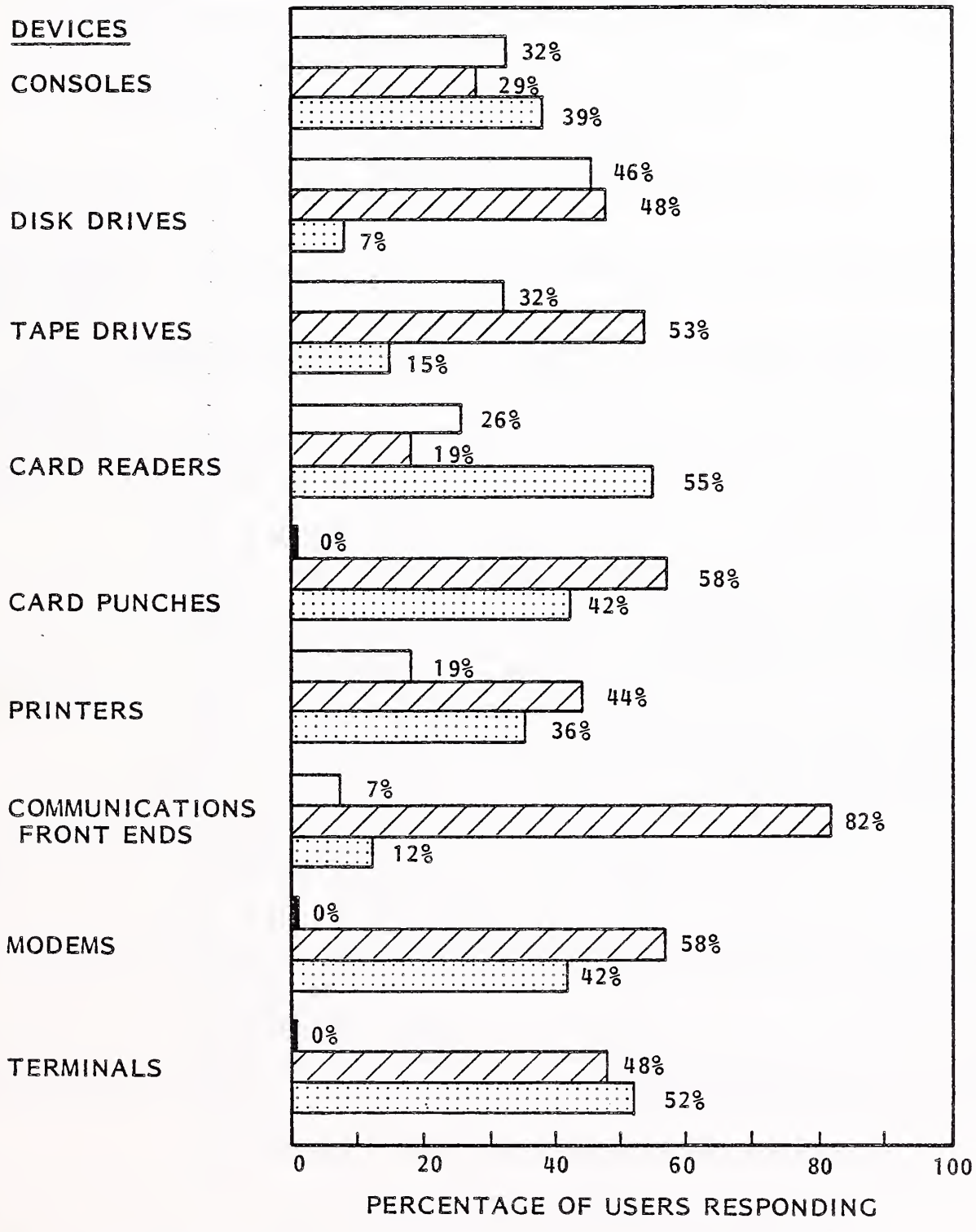

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EXHIBIT IV-41

RESPONDENT USERS' MINIMUM ACCEPTABLE
MEAN TIME BETWEEN FAILURES

EUROPE

MINIMUM ACCEPTABLE MEAN TIME	VERY LARGE	LARGE	MEDIUM	SMALL	TOTAL	
					RE-SPONSES	PERCENT-AGE
LESS THAN OR EQUAL TO ONE WEEK	1	7	1	6	15	12%
	1%	6%	1%	5%		
MORE THAN ONE WEEK AND LESS THAN OR EQUAL TO ONE MONTH	7	10	17	14	48	38%
	6%	8%	14%	11%		
MORE THAN ONE MONTH AND LESS THAN OR EQUAL TO SIX MONTHS	9	16	14	13	52	42%
	7%	13%	11%	10%		
MORE THAN SIX MONTHS	0	4	1	5	10	8%
	0%	3%	1%	4%		
TOTAL	17	37	33	38	125	100%

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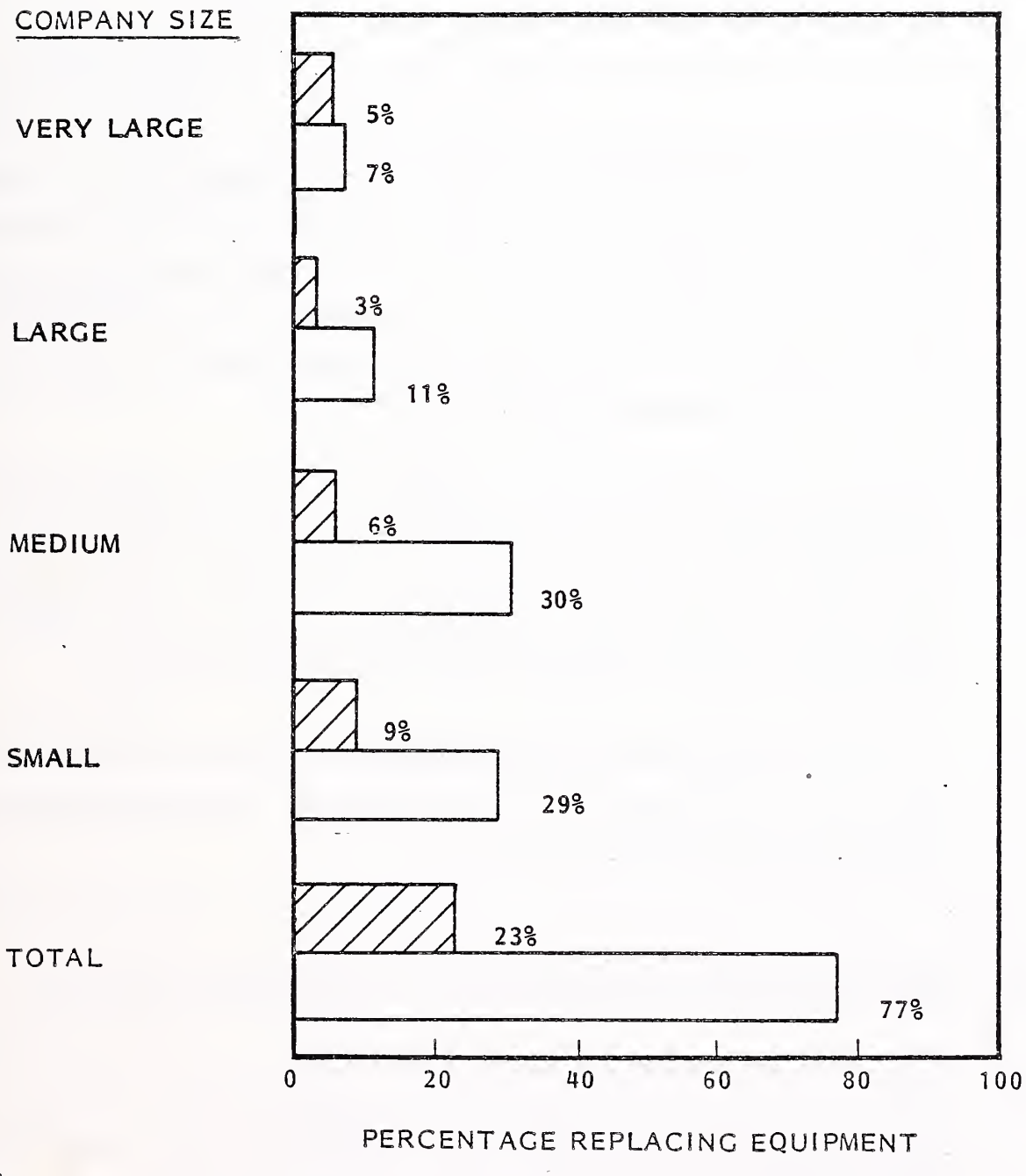
EXHIBIT IV-42

RESPONDENT USERS' REPLACEMENT OF EQUIPMENT
DUE TO DOWNTIME IN THE PAST TWO YEARS

EUROPE



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- Essentially, users would prefer to be able to rely on their systems for a month or more without seeing an engineer.

- Significant numbers of users (nearly 25% of the entire sample) have replaced equipment over the past two years due to downtime (see Exhibit IV-42), particularly the very large companies. Exhibit IV-42 takes the sample of end users, breaks them down by company size and separates each user size category into those that have replaced equipment and those that have not.

- 42% of very large companies have taken action due to downtime, compared with 27% of large users, 20% of medium sized companies and 31% of small users. It is, of course, easier for the smaller user to replace equipment, because his investment in software tends to be proportionally lower than the larger companies, whereas the larger companies are not only the target of much competition but also capable of attracting special deals from the equipment vendors because of the size of their account.

- Exhibit IV-43 identifies the type of equipment replaced. Usually this centres on terminals (easily replaced, low impact on system or software) and to a lesser extent printers, tape drives and disks. This clearly demonstrates the reluctance of European users to change once a choice has been made, even though they may be very unhappy with the equipment's performance.

- In contrast, in the United States significant percentages of users have replaced tape drives, disk drives, printers, communications front ends, consoles and even large/medium sized mainframes.

G. USER PREFERENCE FOR CONTRACT TYPE AND SHIFT COVERAGE

- Since end user preference is heavily biased towards receiving reduced cost/-customized maintenance service, (or at least a service which has been adapted/adjusted for their requirements), INPUT examined several options that might be attractive in moving towards a lower cost and/or more effective service.

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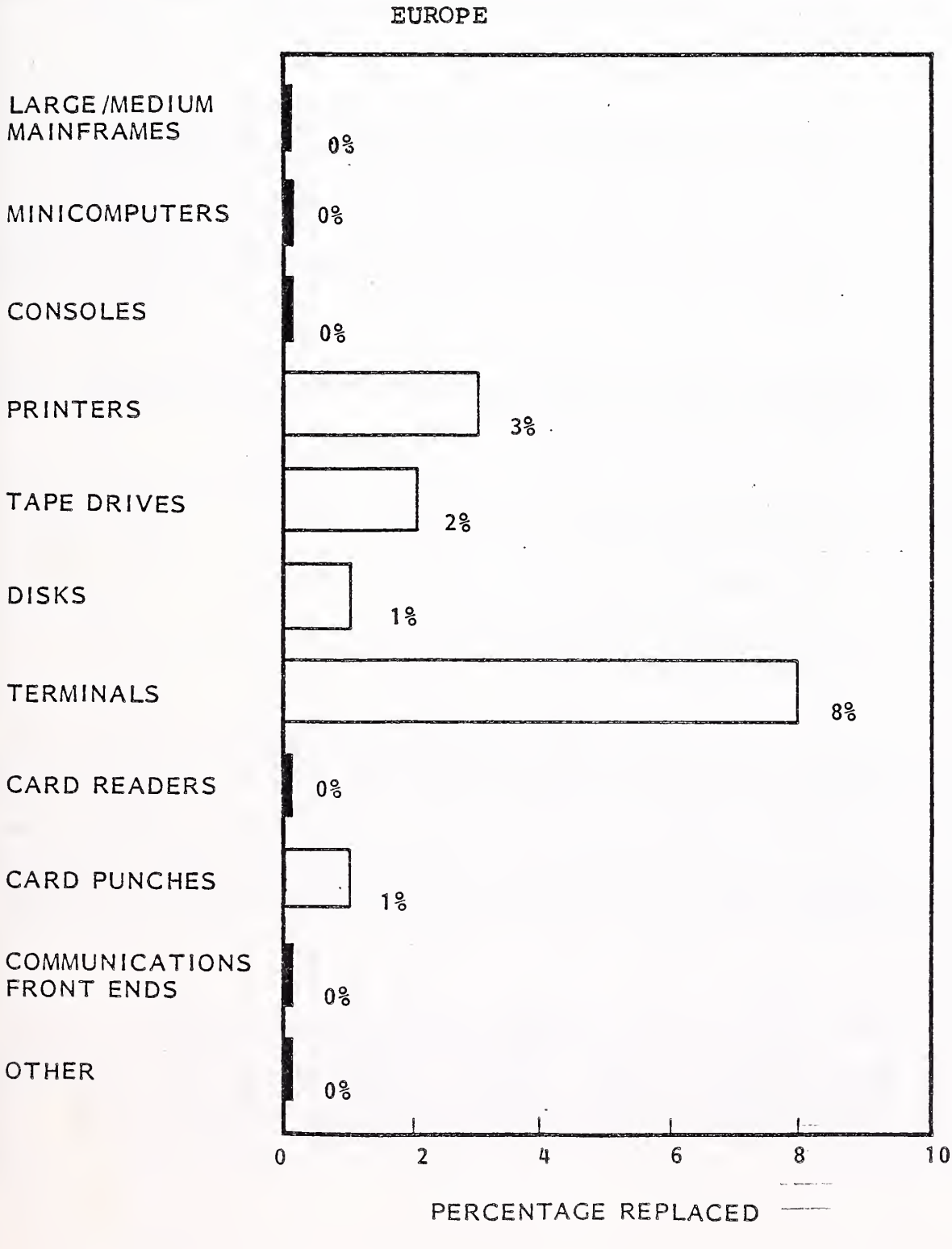
EXHIBIT IV-43

RESPONDENT USERS' REPLACEMENT OF EQUIPMENT
DUE TO DOWNTIME IN THE PAST TWO YEARS
BY (EXPANDED) CLASS OF EQUIPMENT



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- The first was to see if there was user interest in obtaining service on a time and materials basis, as opposed to standard contract. This idea was emphatically rejected (see Exhibit IV-44).

- The next was to identify where the main shift coverage requirements lay (see Exhibit IV-45):

  - two shift coverage of weekdays handles 52% of requirements, while three shift coverage of weekdays covers 71% of all needs,
  - single shift coverage of saturdays and sundays is a rare requirement,
  - three shift coverage of seven days is twice as high as two shift of seven days.

- This suggests that maintenance service coverage could be simplified, at least for larger companies to cover:

  - one shift, five days,
  - two shifts, five days,
  - two shifts six days,
  - three shifts five days,
  - three shifts seven days.

- In order to save costs, INPUT suggested that users might be willing, given adequate cost savings as an inducement, to take on the maintenance of their own systems, (see Exhibit IV-46). This question perplexed a large number of users who were unprepared for a commitment at this stage. Although not expressed clearly, this presumably means they do not feel they are capable of it.

- Among those who were prepared to answer, over half of the very large users were prepared to consider it, and most thought that a 21 - 30% cost reduction would be sufficient motivation for taking over their own maintenance.

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EXHIBIT IV-44

RESPONDENT USERS' PREFERENCE FOR CONTRACT OR TIME AND MATERIAL MAINTENANCE SERVICE

EUROPE

EQUIPMENT CLASSIFICATION	VERY LARGE		LARGE		MEDIUM		SMALL	
	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT
LARGE AND MEDIUM MAINFRAMES	1	15	0	26	0	35	1	28
SMALL BUSINESS COMPUTERS	1	6	0	6	1	9	1	3
OTHER MINICOMPUTERS	1	6	0	8	0	4	0	4
PLUG COMPATIBLE PERIPHERALS	0	12	0	9	0	13	1	17
TERMINALS	1	11	1	19	0	23	1	18
TOTAL	4	50	1	68	1	84	4	70

EXHIBIT IV-45

RESPONDENT USERS' MAINTENANCE
COVERAGE REQUIREMENTS

EUROPE

MAINTENANCE COVERAGE	VERY LARGE	LARGE	MEDIUM	SMALL	TOTAL RE-SPONSES	PERCENT OF TOTAL
ONE SHIFT/ FIVE DAYS	3	5	11	10	29	26%
ONE SHIFT/SIX DAYS	0	1	0	0	1	1%
ONE SHIFT/SEVEN DAYS	0	0	0	1	1	1%
TWO SHIFTS/FIVE DAYS	2	6	17	4	29	26%
TWO SHIFTS/SIX DAYS	0	2	1	4	7	6%
TWO SHIFTS SEVEN DAYS	1	0	3	1	5	5%
THREE SHIFTS/FIVE DAYS	5	8	6	2	21	19%
THREE SHIFTS/SIX DAYS	3	2	0	1	6	6%
THREE SHIFTS/SEVEN DAYS	3	3	1	4	11	10%
TOTAL RESPONSES	17	27	39	27	110	100%

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EXHIBIT IV-46

RESPONDENT USERS' REQUIRED COST SAVINGS FOR PERFORMING THEIR OWN MAINTENANCE

EUROPE

COST SAVINGS REQUIREMENT	ENTERPRISE SIZE				TOTAL RE-SPONSES	PER-CENTAGE OF RE-SPONSES
	VERY LARGE	LARGE	MEDIUM	SMALL		
10% OR LESS	1	1	0	1	3	4
11-20%	0	1	1	2	4	6
21-30%	2	0	2	0	4	6
OVER 30%	1	1	6	1	9	13
TOTAL THAT WOULD CONSIDER	2	0	1	2	5	7
WOULD NOT CONSIDER	5	11	15	15	46	65
TOTAL	11	14	25	21	71	100%

- In all other size groups of users 60 - 70% of those who agreed to reply would definitely not consider such an option. This basically can be summarized as a non-starting option, with the possible exception of a few, very large end users.

- The next step was to examine whether part of the maintenance function could be performed by the end-user (see Exhibit IV-47).

- Overall the results are encouraging:

  - nearly 45% of all users (59 out of 132 respondents) are already performing some diagnostic runs and a further 28% would consider doing so (total 73%),

  - 14% already install their own equipment and an almost equal number would consider doing it,

  - only 6% currently perform any maintenance but 17% would consider doing part of it,

  - very few would consider delivering faulty equipment for repair by the vendor.

H. THIRD PARTY MAINTENANCE USAGE

- The predominant reason for considering third party maintenance services, according to the users interviewed, is the cost saving that users believe can be achieved, (see Exhibit IV-48).

- In some cases, the equipment in use is not locally supported by the manufacturer, and so the use of third party services is normal.

- In the case of very large, multi-vendor installations, users are increasingly interested in having sole-source support, and find third party maintenance an attractive alternative to multiple vendor personnel.

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EXHIBIT IV-47

RESPONDENT USERS ACTUALLY OR POTENTIALLY PERFORMING MAINTENANCE TASKS, BY COMPANY SIZE

EUROPE

TASK	PRESENTLY PERFORMING				TOTAL	WOULD CONSIDER PERFORMING				TOTAL	PERCENTAGE PRESENTLY OR POTENTIALLY PERFORMING					PERCENT
	VL	L	M	S		VL	L	M	S		VL	L	M	S	TOTAL	
INSTALLING EQUIPMENT	2	5	5	6	18	3	3	6	4	16	25%	24%	28%	25%	34	26%
RUNNING DIAGNOSTICS	11	17	14	17	59	5	10	14	9	38	80%	82%	72%	65%	97	73%
PERFORMING MAINTENANCE	0	0	4	4	8	3	7	5	7	22	15%	21%	23%	28%	30	23%
DELIVERING FAULTY EQUIPMENT FOR REPAIR	0	1	0	2	3	2	4	4	3	13	10%	15%	10%	13%	16	12%

VERY LARGE=VL
LARGE =L
MEDIUM =M
SMALL =S

EXHIBIT IV-48

REASONS FOR RESPONDENT USERS' CONSIDERATION OF UTILIZING THIRD PARTY MAINTENANCE SERVICE

EUROPE

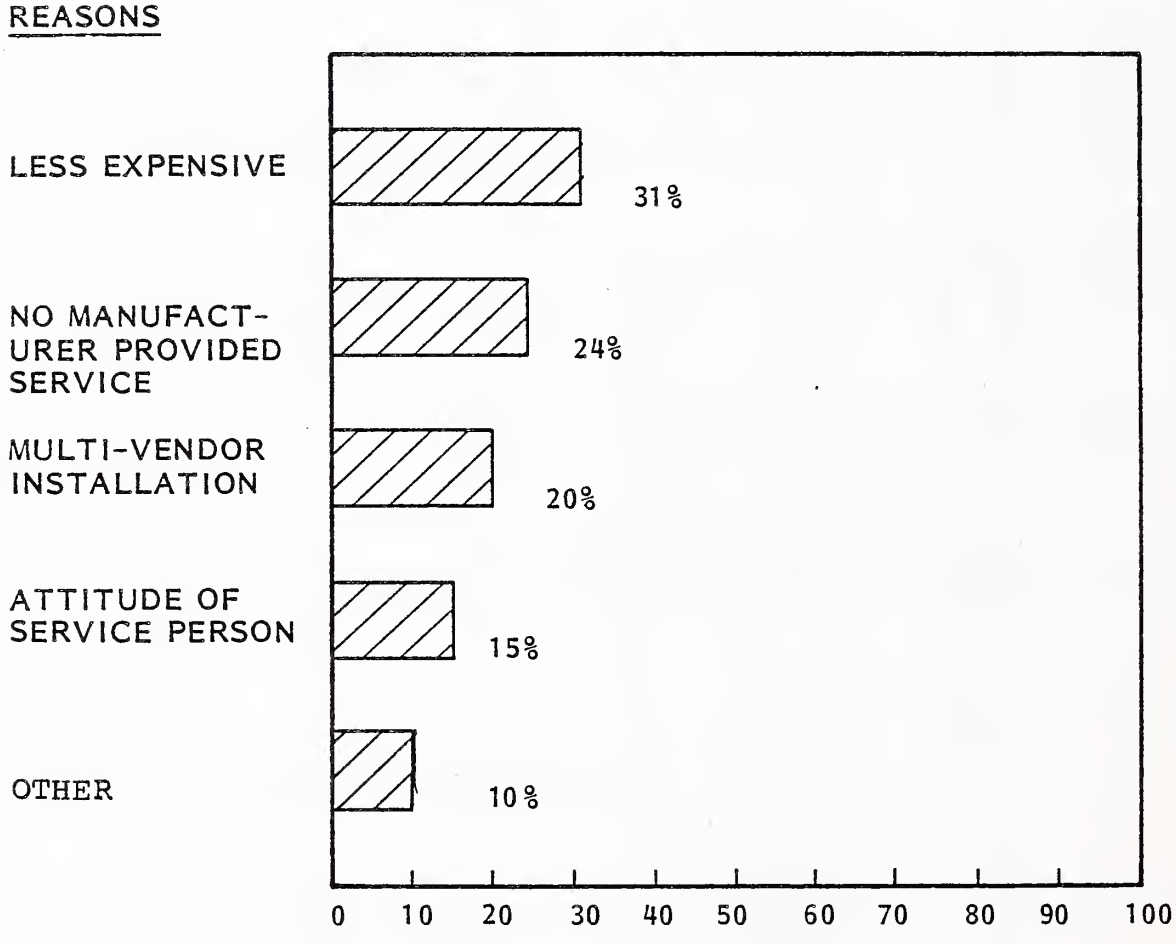

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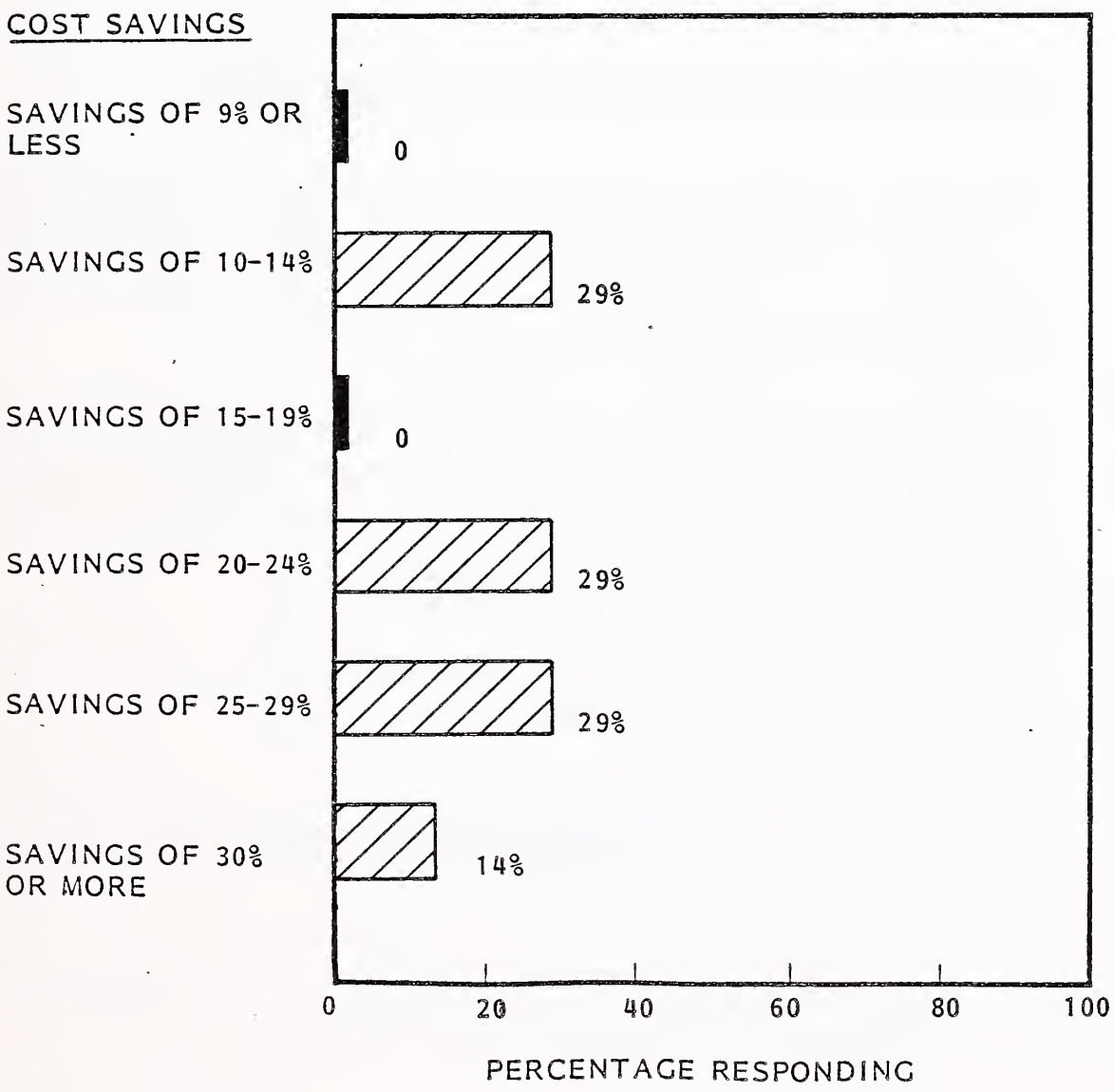
EXHIBIT IV-49

PERCENTAGE COST SAVINGS REPORTED BY RESPONDENT USERS FOR THIRD PARTY VS. MANUFACTURER SUPPLIED MAINTENANCE

EUROPE



WEST GERMANY - FOUR USERS WOULD CONSIDER THIRD PARTY MAINTENANCE IF LESS EXPENSIVE BUT DO NOT INDICATE THE % OF COST SAVINGS REQUIRED.

UNITED KINGDOM - TWELVE USERS STATED A COST SAVING AS A REASON. ONLY FIVE GAVE A RANGE.

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- Significantly, the attitude of the service person was also mentioned as a reason for user's consideration of third party services.

- The percentage cost savings reported by respondent users for third party services versus the manufacturer services they would normally be using, varied between 10 and 30%. Equal proportions of the 16 users who currently use TPM have obtained between 10 - 14%, 20 - 24% and 25 - 29% cost reduction, (see Exhibit IV-49).

I. UNSATISFIED NEEDS AND MEANS OF IMPROVING SERVICE

- Clearly identified as the most imortant user needs, not now being satisfied are the inadequate response time already explored, and part availability, which, if it has come to the attention of the users themselves, must be a significant problem for the vendors, (see Exhibit IV-51).

- The second tier of problems concern (i) better diagnostics and (ii) poorly trained field engineers, which complement each other partially. Again, that users should be able to perceive the inadequacy of training of the engineers is an indication of a serious problem for vendors.

- The third area of user concern should not be a concern for the vendor, other than the manner in which he packages the response:

  - certain end users feel there is a need to pay more attention to the preventive maintenance (presumably in the hope that this would help the reliability of their systems),

  - vendors say (or at least have convinced themselves) that less preventive maintenance is now required by modern products.

- It is not going to be easy to convince the user that this is so, and it will be necessary for vendors to tread carefully on their approach to this problem.

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THIRD PARTY MAINTENANCE VENDORS IN WESTERN EUROPE

o UNITED KINGDOM

- Computer Field Maintenance (CFM)
- Electronic Associates Limited (EAL)
- Systems Reliability Limited (SRL)
- Cable & Wireless
- CODE
- Systems Maintenance and Services (SMS)
- Westrex
- Extel
- Mills Associates

o FRANCE

- SYDEL
- Societe Industrielle d'Informatique (Sii)
- Raytheon Service Company
- SODETEG
- SOFREMA

o WEST GERMANY AND HOLLAND

- NONE FOUND

EXHIBIT IV-50

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EXHIBIT IV-51

RESPONDENT USERS' PERCEPTIONS OF SERVICE NEEDS NOT NOW BEING SATISFIED

EUROPE

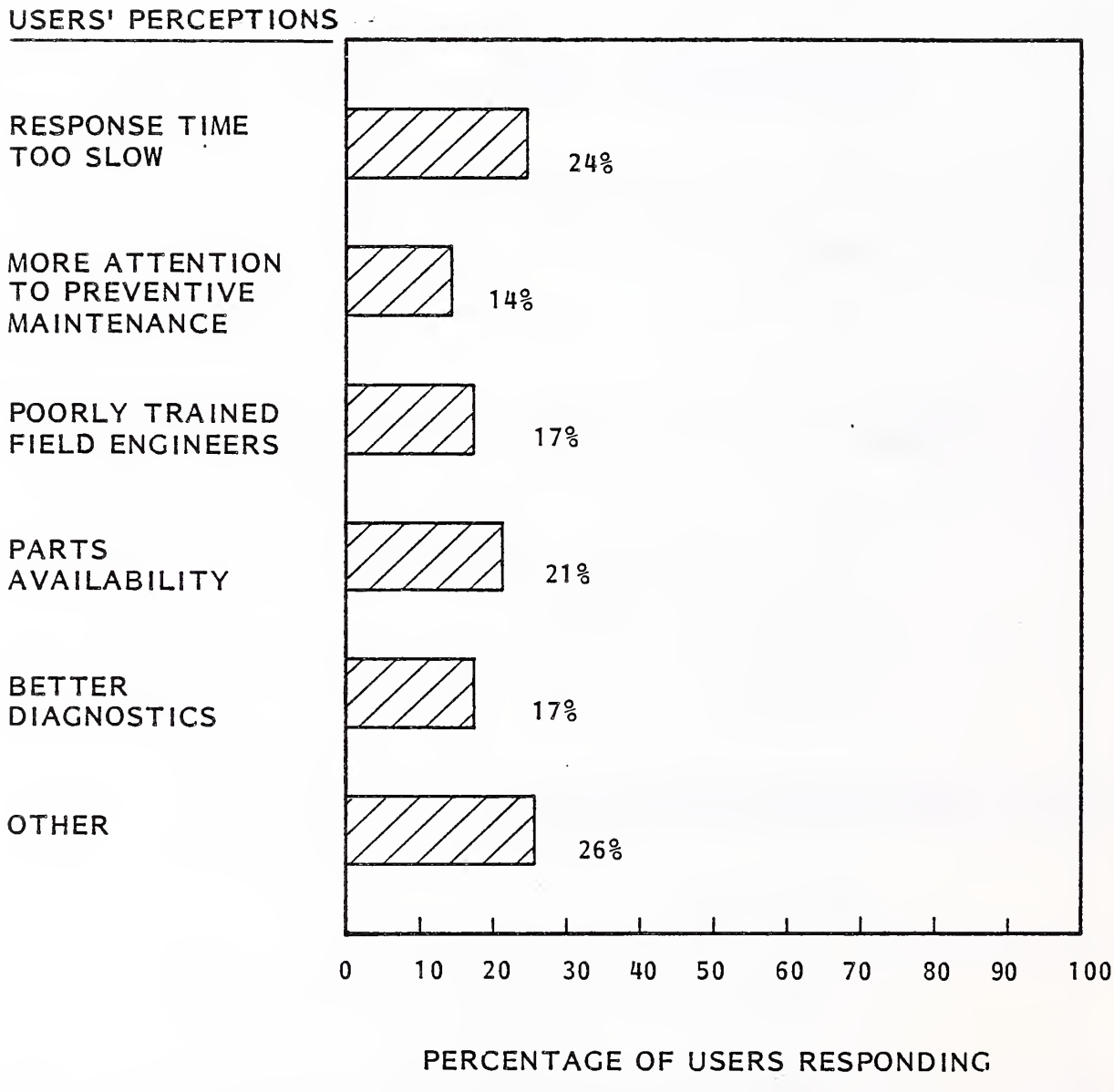

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EXHIBIT IV-52

COST SAVINGS REQUIRED FOR RESPONDENT USERS TO ELIMINATE PREVENTIVE MAINTENANCE

EUROPE

RESPONDENTS' REACTIONS	SIZE OF COMPANY				TOTAL
	VERY LARGE	LARGE	MEDIUM	SMALL	
WOULD NOT ELIMINATE	16%	23%	22%	20%	81%
WOULD FOR 5% OF CONTRACT COST	.25	.25	.25	.75	1.5
WOULD FOR 5-10% OF CONTRACT COST	.75	0	1.5	1.3	3.5
WOULD FOR 11-20% OF CONTRACT COST	0	0	3	2	5
WOULD FOR 21-30% OF CONTRACT COST	2	0	.25	.75	3
WOULD FOR >30% OF CONTRACT COST	.25	.25	6.5	0	7
TOTAL	19%	23.5%	33.5%	25%	100%

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- This is amply demonstrated by Exhibit IV-53 where users were asked what cost savings would they require in order to eliminate PM: 81% said they would not accept its being eliminated. Even at 30% cost reduction, users were not interested.

- It is further backed up by the fact that the vast majority of users are prepared to provide prime time for the carrying out of preventive maintenance (see Exhibit IV-53).

- In defining what can be done to improve service, twelve options were selected by users (see Exhibit IV-54). First and foremost among these was a faster and more effective response to failure calls. Second was improved availability of parts. These and the other items listed are consistent with earlier comments from users.

J. MAINTENANCE PERSONNEL CHARACTERISTICS

- A number of personnel characteristics were proposed to users to see if there were preferences or dislikes, (see Exhibit IV-55).

- To begin with there is absolutely no preference for male or female maintenance staff. When the maintenance person is male, there is a slight preference for him presenting himself in a formal shirt and tie, athough no uniforms are necessary.

- There is a strong prediction for his being present on site, particularly for larger users, although the smaller users have a sharp dislike of this practice.

- Overwhelmingly, the user wishes the same individual to take care of servicing his equipment: he feels that in this way his own particular needs may be better understood and a rapport may be established with the maintenance person, avoiding lengthy communications on the history of past faults, instruction as to the status of the customers contract and all other similar factors that have a bearing on how the use feels he should be treated.

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EXHIBIT IV-53

RESPONDENT USERS' SCHEDULE FOR

PREVENTIVE MAINTENANCE

EUROPE

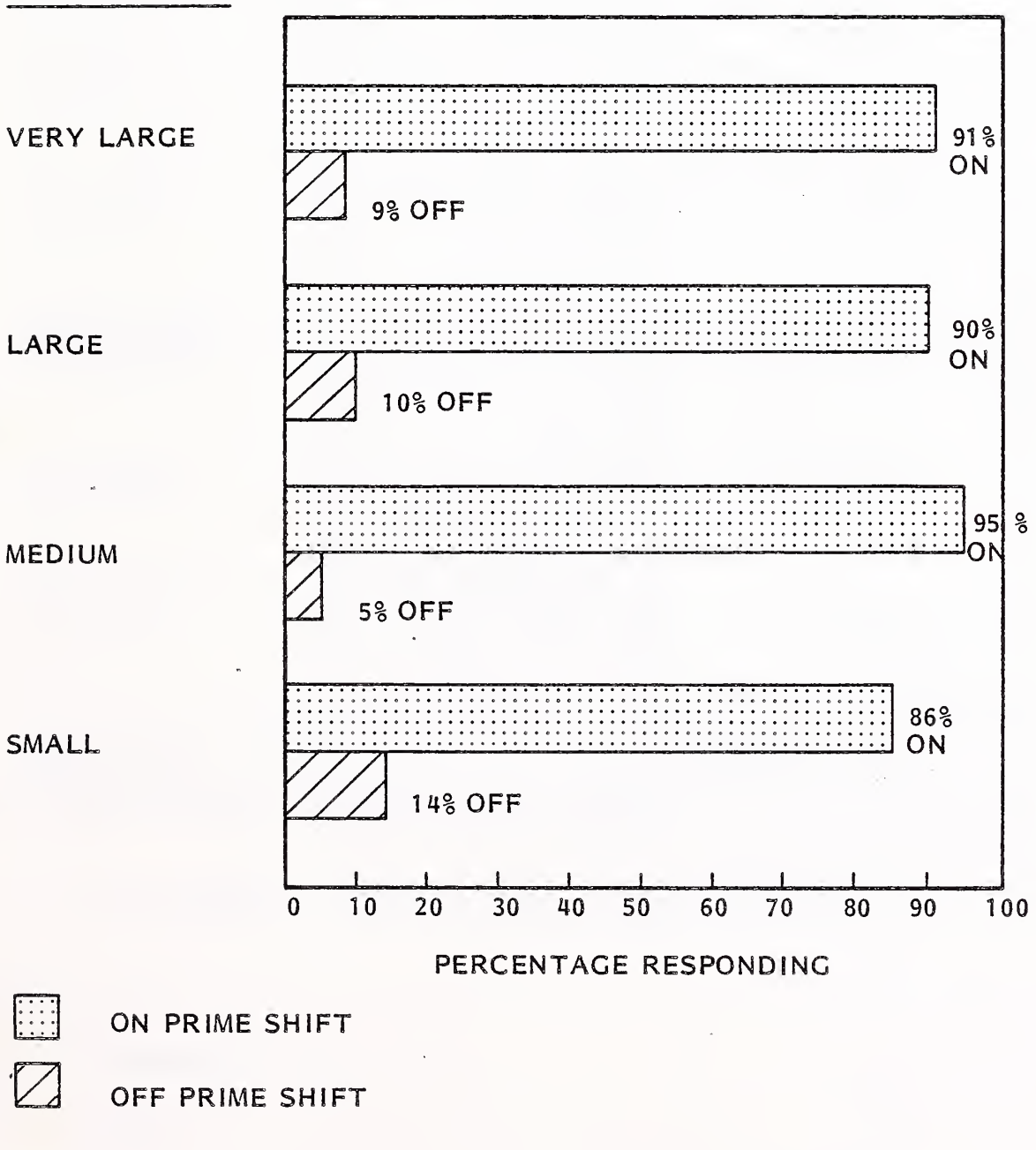

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EXHIBIT IV-54

RESPONDENTS USERS' PERCEPTION OF

MEANS TO IMPROVE SERVICE

EUROPE

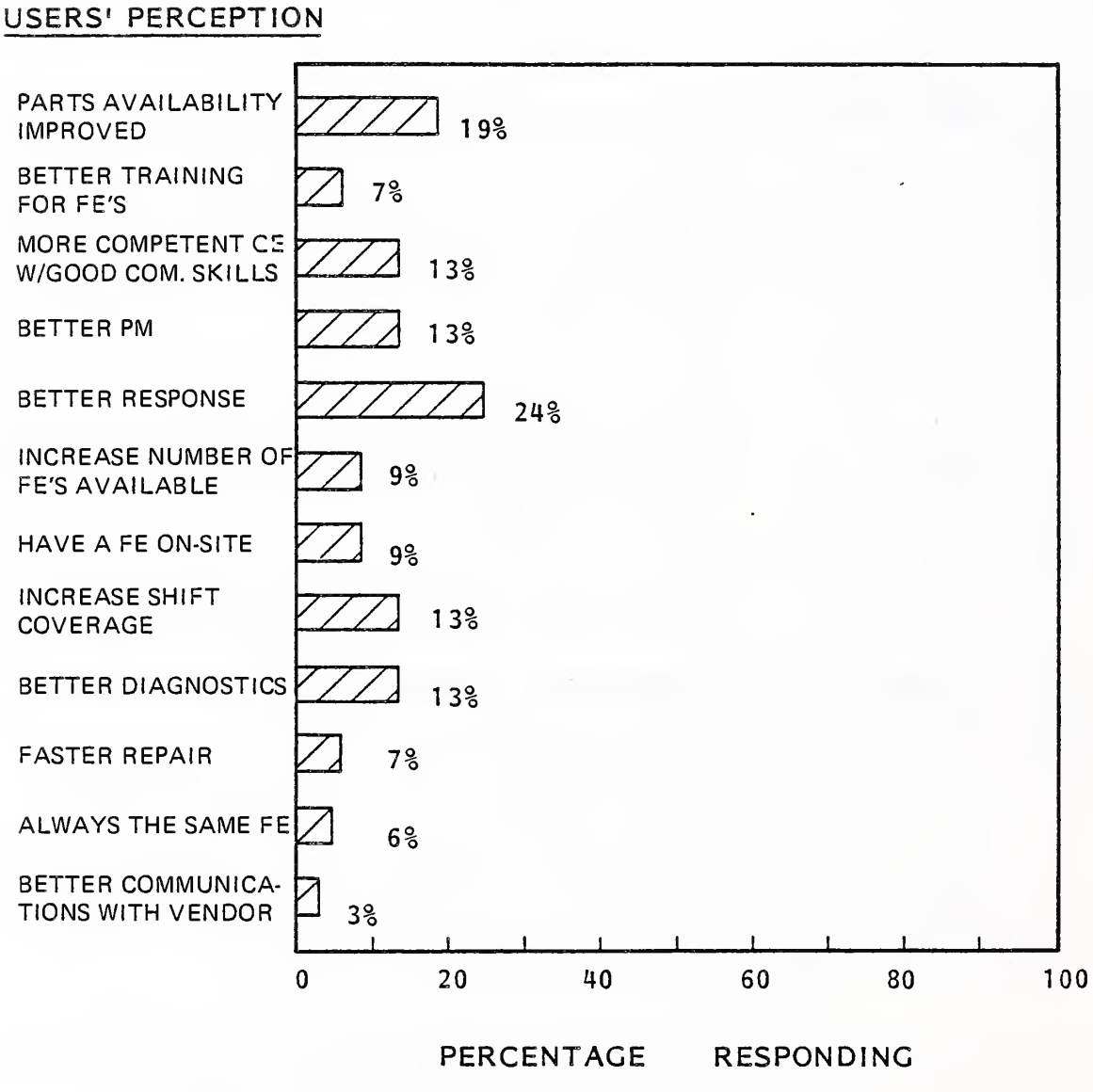

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EXHIBIT IV-55

RESPONDENT USERS' PREFERENCE TOWARDS
MAINTENANCE PERSON'S CHARACTERISTICS

EUROPE

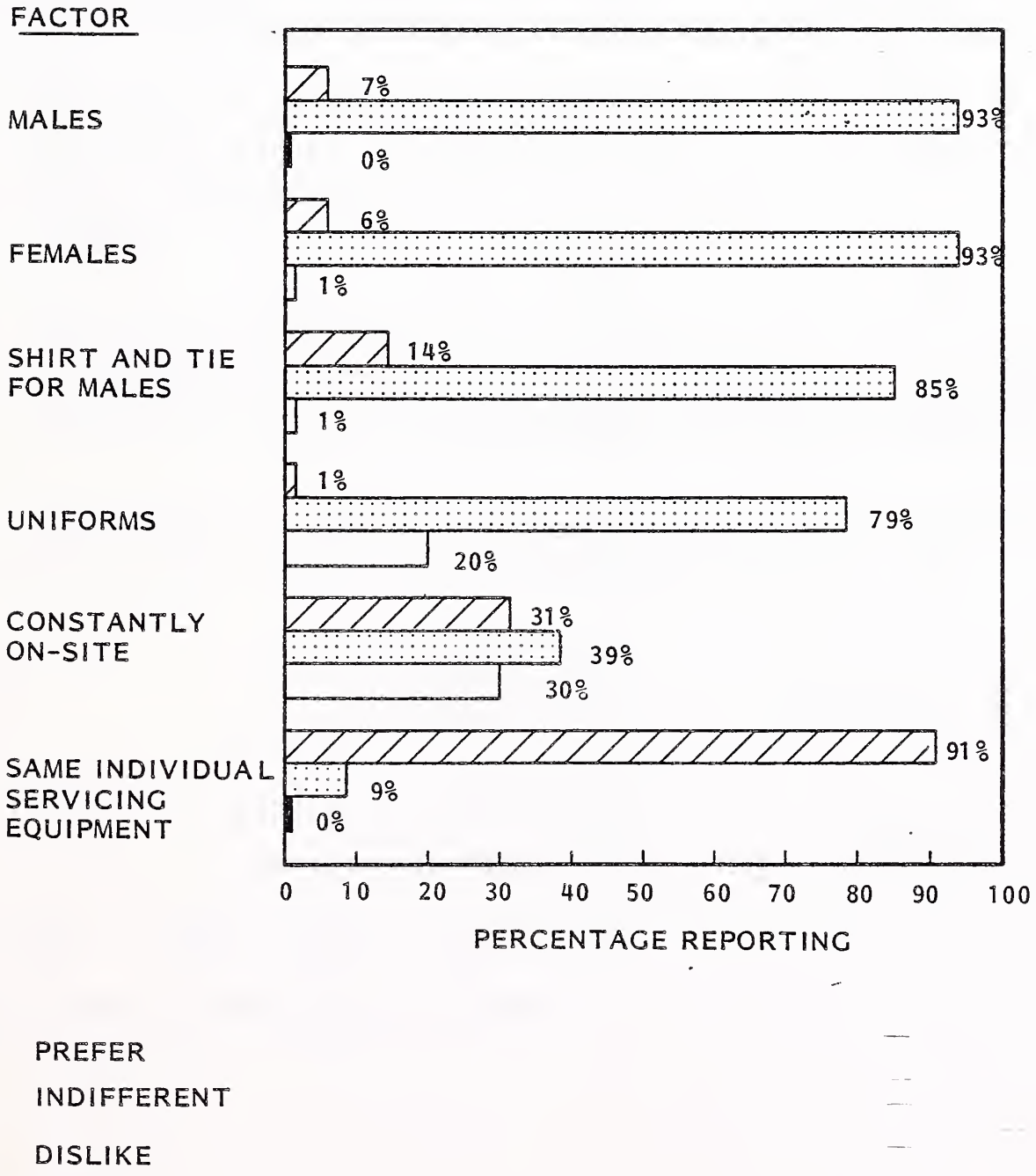

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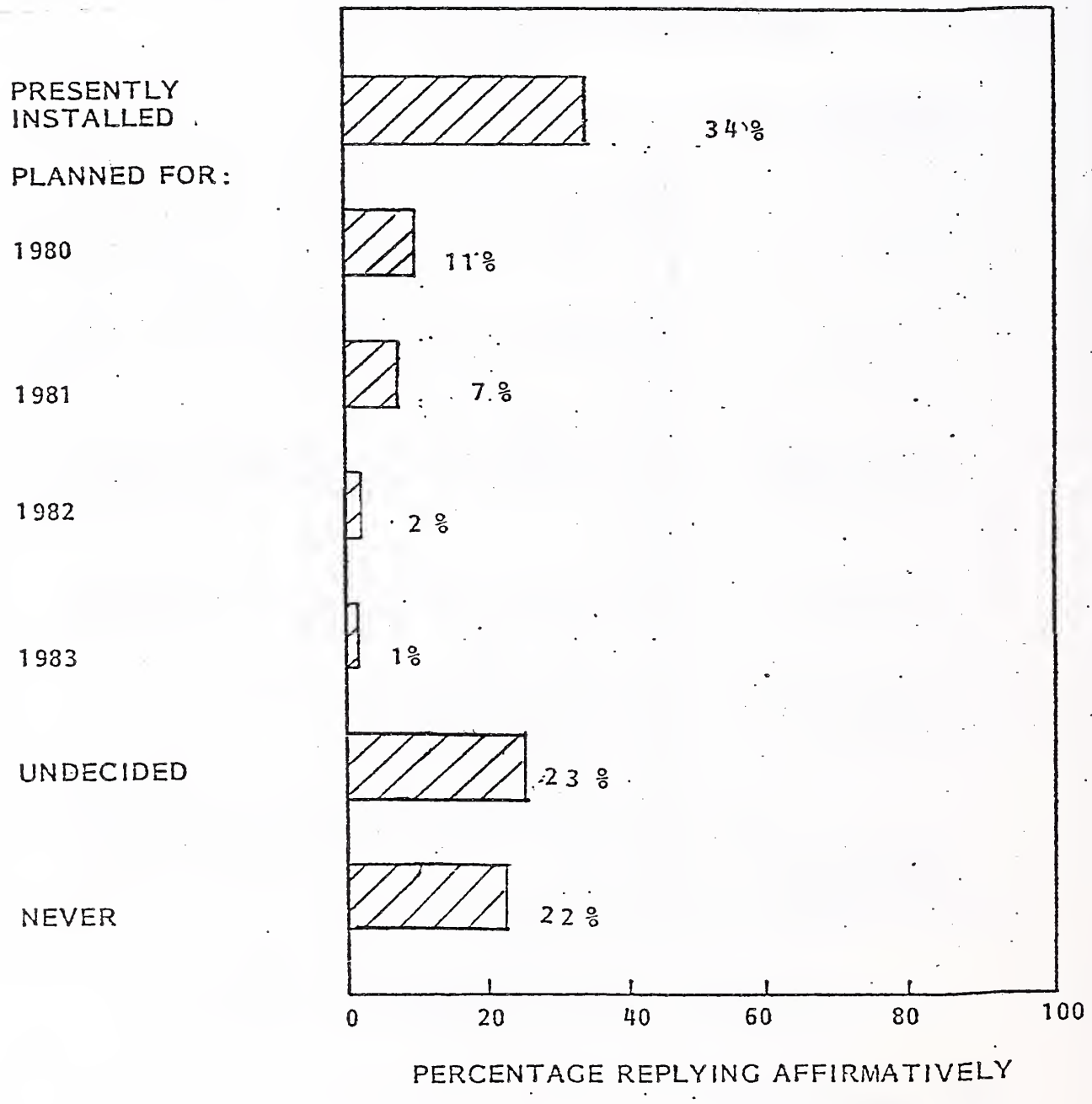
EXHIBIT IV-56

PERCENTAGE OF RESPONDENT USERS
WHO HAVE PLANS FOR DISTRIBUTED DATA PROCESSING

EUROPE



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K. DISTRIBUTED DATA PROCESSING PLANS

- The adoption of distributed data processing by users can have a significant impact on vendor maintenance costs due to the multiplication of sites to be serviced and the overall reduction of the value of the average installed site.

- In Exhibit IV-56, user usage and plans for DDP were explored. Over one third felt that what they have at present represents a form of DDP.

- With regard to future plans, 23% remain undecided and a further 22% are against the implementation of DDP, either through fear of losing the control of their centralized processing sites offer or simply because it is considered unsuitable.

- Formal plans for DDP were therefore restricted to 21% of those that were interviewed and these showed a normal pattern of distribution: 11% in the first year, 7% in the second, dropping of rapidly to 2% in 1982 and 1% in 1983.

- As time goes by the "never" and "undecided" will gradually provide additional sources of DDP candidates, as conditions and requirements change.

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V. ANALYSIS OF THE INFORMATION PROCESSING INDUSTRY VENDOR SURVEY

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V. ANALYSIS OF THE INFORMATION PROCESSING INDUSTRY VENDOR SURVEY

- With two exceptions, (both U.S. Mainframe manufacturers), the vendors interviewed were:

  - well informed on the performance of their maintenance organization

  - frank in their discussions on all of the questions asked by INPUT, (which included company-sensitive data on salary ranges, internal personnel problems, intended source and growth of the field maintenance force and weaknesses of the present maintenance service),

  - able to respond (i.e. in a position of authority with regard to the data provided), although not always in possession of adequate data on their maintenance operations.

- The European maintenance operations of the two U.S. equipment manufacturers referred to were unable to respond without U.S. parent company approval, and, when this approval was given, showed a lack of knowledge of their maintenance service performance compared to the other respondents.

- There were no refusals for interview, but few respondents were able to schedule interviews immediately and some interviews were put off several times which resulted in serious delays in the production of this report. In contrast, the end user interviews were completed on time.

- All of the companies interviewed were convinced of:

  - the importance of maintenance service as a competitive tool,

  - the growing requirement for maintenance personnel to handle system support needs (i.e. basic software maintenance and repair, in addition to the traditional role of hardware maintenance and repair),

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- the need for maintenance services to be treated as a profit centre, generating a high level of revenue,

- the importance of continuous training programs to maintain the level of technical knowledge of their field engineers,

- the need to better educate users in their understanding of what to expect from their systems and how to distinguish between actual system downtime/failure and normal downtime due to foreseeable or planned operations.

- The means of achieving some or all of the above vary enormously. What follows is a reasoned examination of the attempts being made by vendors to resolve the problems they all agree on.

A. IMPORTANCE OF THE MAINTENANCE FUNCTION

- Without exception among the vendors interviewed, the Manager of Field Engineering (or equivalent title) reports to the General Manager of the European Company. This is not expected to change in the coming years.

- Each manager of field engineering has a selection of the following functions reporting to him:

  - field engineering operations (field staff): can be limited to the field engineers themselves but is increasingly inclusive of branch manager functions which includes marketing and systems support, technical operations (systems analysis/design) and local branch administration,

  - technical services: usually include field change order (FCO) implementation, education and facilities planning (installation design),

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EXHIBIT V-1

IBM DP DIVISION'S SYSTEM SUPPORT SERVICE CONCEPT AND IT'S IMPLICATIONS

ORGANISATION

- IBM Support centres providing DP Division customers with problem solving services/assistance.
- Strict dividing line between services that are provided for on a paying basis and those that are free of charge.
- Services are at system level (hardware plus software) and concern installation planning, remote and local problem diagnosis/assistance, and remote and local problem solving.

NON-CHARGEABLE ITEMS

- Installation Planning
- Problem processing through IBM's Authorised Programming Analysis Reports (APARS), and corrections through Program Temporary Fixes (PTFs).
- Remote Support Centre Assistance (i.e., by telephone); determining whether a problem arises from hardware or software: this is provided as part of the maintenance coverage.

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EXHIBIT V-1 (CONT'D)

CHARGEABLE ITEMS

- Problems caused by non-IBM equipment or customer modifications to IBM software.
- On site support by IBM representative.
- Hourly rate or monthly charge basis.
- Single machine, one-off charges.
- Decreasing rates for multiple machine support.

CUSTOMER RESPONSABILITIES

- installation and verification of system control programs and licensed programs
- problem identification (whether hardware or software)
- problem source identification (for software problems only)
- application of corrections.

TERM

- Twelve month periods, renewable.
- Termination charge if support is cancelled within first year; month's notice thereafter.
- Starts January 1, 1980.

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- spare parts centre(s): the on-going analysis of requirements by part number, inventory control, parts distribution, parts sales administration, board/chip repair and diagnostics, plus the management of the centre(s),

- new product engineering: the design evaluation of all new products, the setting of maintainability targets, the prototype test, monitoring and initial installation evaluation,

- third party maintenance co-ordination: for those devices/systems that have partial/complete support in one or all of the countries covered: co-ordination and monitoring of the service provided by external organisations,

- personnel/administration: for the total staff reporting, (which can be from 20 to 10,000 people).

- Maintenance personnel are normally organised by region (or "Sector") within country, where "region/sector" can correspond to anything from a notional geographic area - e.g. "North", to a precise subset of nationally recognized zones.

- Over the last ten years, all of the mainframe equipment manufacturers have progressed towards the inclusion of basic system software support (and, to a certain extent, basic system software maintenance) in the role of the field engineer. This was initially intended to reduce the company/user interface to one man and thereby eliminate any arguing between field engineer and software support personnel in front of the client, as to who was responsible for a system failure.

- This now appears to be a far-sighted (or fortuitous) choice, since over the next five years an increasing proportion of basic system software coding will be achieved in firmware. This physical implementation of software in hardware can only be supported and maintained by a field engineer.

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EXHIBIT V-2

AVERAGE PROPORTION OF REVENUE BY SOURCE, MAINFRAME VENDORS CURRENT AND FORECASTED

		% OF TOTAL 1978	% OF TOTAL 1983
•	HARDWARE		
-	CPU & memory	20	14
-	Peripherals	50	44
•	SOFTWARE		
-	system	1	2
-	application	3	6
•	SUPPORT		
-	hardware/maintenance	18	23
-	system software support (1)	-	1
-	education	1	2
		100	100

(1) will gradually become the responsability of field engineer.

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- But IBM has gone one step further for mainframe products, (see Exhibit V-1). In essence this is a combination of the "support centre" approach (adopted earlier by others for small systems) with the remote diagnostics support for hardware already practised by some vendors.

- There are two significant additions however. One is that users are given the responsibility of implementing all of the changes and new versions of software that IBM produce (and must do so with a limited period of time). The second is that the support centre is accessed remotely (by telephone).

- If in-person assistance is required, this occurs at the user's site with the IBM representatives present on a paying basis. This means that the support centre is basically a "no-go" area for end users and is a good opportunity for IBM to integrate hardware and software expertise.

- The inevitable consequence of this approach will be that the quality of support provided on-site by IBM will have to be boosted to a high level, since the rates charged will ensure that the users will be critical of the assistance provided (they will not pay invoices for low-performance assistance).

- The trend is being established for users to rely more heavily on their own ressources to manage, implement and support their own systems when they are implemented in software, and for the manufacturer to take responsibility for the hardware alone, (which will include software functions implemented in firmware).

- System support wil continue to be provided by the equipment vendors, and software and system implementation services (system support services) will grow from a current 3% of total vendor revenue to 8% within five years time.

- At the same time maintenance revenue will grow as a proportion of total revenue due to the steady rise in maintenance prices (prompted by the rise in manpower costs) and the gradual inclusion of system software in the configuration being maintained, (see Exhibit IV-2).

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EXHIBIT V-3

FIELD MAINTENANCE ENGINEER FORCES
INCREASE 1977, 1978 AND
PROJECTED GROWTH TO 1983

TYPE OF RESPONDENT	NUMBER OF ENGINEERS WITH RESPONDENTS		AVERAGE % GROWTH		% U.S. GROWTH RATE TO 1983
	1977	1978	1978	TO 1983	
MAINFRAME	5,768	5,996	4%	6%	9.2%
SMALL BUSINESS/ MINICOMPUTER	562	640	14	14	15.0
TERMINALS	527	589	12	26	29.4
THIRD PARTY MAINTENANCE	98	126	29	25	18.7
OTHER	225	258	15	10	30.0
ALL VENDORS COMBINED (WEIGHTED*)	7,180	7,609	6%*	9%*	15.3%

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B. GROWTH OF THE FIELD MAINTENANCE FORCE

- With the exception of the third party maintenance vendors, the rates of growth of European manufacturer field engineer forces are less than their U.S. counterparts (see Exhibit V-3).

- The highest rate of growth is found in the manufacturers of terminals who anticipate a doubling of their growth rate in the 1979/1983 period, over that experienced in the 1978/79 period.

- Small business and mini computer field engineer forces are planned to expand at a steady 14% per annum, only slightly better than that of the same U.S. category.

- Mainframe suppliers, on average, intend growing their field engineer force at a moderate 4 - 6%. Taken on a vendor by vendor basis, some of the large mainframe suppliers intend freezing their field force of its present staff level, replacing only the losses of retirement and normal attrition.

- The overall weighted 1979/1983 growth rate of the European vendors field maintenance manpower is thus substantially less than that of U.S. vendors, (9% as opposed to 15.3%). Yet nearly all of the vendors interviewed say that they base their estimates of field maintenance manpower requirements on the marketing forecasts provided to them.

- This would suggest that either the marketing forecasts are seriously diminished before being applied to maintenance requirements (i.e. that they are not believed) or that there is a discernable upwards trend of the workload, (in number of units and or sites) that a field engineer is capable of servicing.

- Alternatively vendors may be assuming that new techniques of remote diagnostics, board/parts exchange rather than repair, and the delegation of new responsibilities to the user himself can be expected to absorb the excess workload created by the growth of the user base.

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EXHIBIT V-4

SOURCE OF FIELD ENGINEERS IN 1978 AND 1982

VENDOR SOURCE OF PERSONNEL	1978 RATING (%)					1982 RATING (%)					VENDOR COMMENTS
	5	4	3	2	1	5	4	3	2	1	
HIRE AND TRAIN YOURSELF	83	15	2	–	–	87	13	–	–	–	"THE ONLY SOURCE FOR LARGE NUMBERS"
RECRUIT FROM COMPETITION	12	–	50	12	14	5	5	10	5	5	"FOR SMALL NUMBERS; NOT ALWAYS A SUCCESS"
RECRUIT FROM OTHER INDUSTRIES	–	–	15	65	15	–	–	10	50	5	"DIFFICULT TO FIND"
ARMED FORCES PERSONNEL	5	5	15	5	30	–	5	5	–	60	"GREAT IF YOU CAN GET THEM"
RECRUIT FROM WITHIN COMPANY	–	5	–	5	30	–	5	–	–	60	"VERY RARE"
TRADE SCHOOLS	–	5	–	–	60	–	5	–	–	60	"WE SPONSOR TRADE SCHOOL ATTENDANCES"
OTHER	–	5	–	–	–	–	5	–	–	–	"UNIVERSITY TRAINEES; BUT VERY HARD TO GET"

C. SOURCES FOR NEW FIELD ENGINEER STAFF

- Despite the lower growth rates in field engineer personnel requirements in Europe, compared to those found in the U.S., there is a constant concern of (i) the lack of availability of trained staff (ii) the regular loss of trained, mature maintenance staff to other functions within the same company or to other companies (not necessarily competition).

- The most significant aspect of in-house losses is that they usually concern the most dynamic individuals within the maintenance organization, who are able to generate forward thinking on maintenance issues. As a result many European maintenance organizations are populated with "mature" staff.

- Building up the bottom of the pyramid with younger members and keeping them is therefore an issue.

- The main source for new field engineer staff for European vendors is the internal program of hiring and training, which received the top rating from 83% of respondents, and is expected to continue to be of prime importance over the next five years period to 1983.

- This single source accounts for ninety percent of all hires for equipment manufacturers. As would be expected, however, the third party maintenance organisations depend heavily on recruiting from the competition, practically the only source of instantly available, fully qualified/experienced field engineers.

- Other sources (see Exhibit V-4) rate very low and have been all but abandoned by the maintenance organizations interviewed. However, one (UK) vendor has found an excellent source in the U.K. Government-sponsored "TOPS" (trade school) training scheme and rated it as his best source of new hires.

- Vendor comments on the sources available for obtaining field engineers included:

  - "you have to grow you own; all other sources are inadequate from a numbers standpoint",

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- "we get a lot from the competition",

- "you only get movers or problem people from the competition , they create problems in the promotion pecking order and are hard to adapt to the way we do things",

- "other industries can provide engineers, but we haven't seriously promoted the idea",

- "engineers are hard to find in other industries",

- "we used to obtain significant numbers of trained armed forces personnel; they are very good if you can get them, but the number is dwindling",

- "it is very rare to find anyone within the company who can be persuaded that becoming a field engineer is an attracive proposition, but half the engineers will move to marketing jobs tomorrow, given the chance",

- "we sponsor trade school attendances to a degree but they are not a heavy factor in my planning",

- "the government sponsored training scheme - TOPS is our best source",

- "university graduates are a source, particularly technical colleges, but you have to sell the idea strongly".

D. TRAINING OF MAINTENANCE PERSONNEL

- All of the vendors and third party maintenance organisations interviewed provide hardware training courses for their staff on an on-going basis. There is no corelation between the number of new hires and the increase in the number of instructors, however, mainly due to:

  - the large number of technology - driven modifications taking place within vendor organisations that require large-scale retraining of existing staff,

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- the increasing degree of specialization, requiring more courses for the same number of students.

- A typical hardware training program consists of the following:

- Average student days, 1978	:	10,000
- 1979 percent increase	:	30%
- Number of instructors, 1978	:	8
- 1979 percent increase	:	50%
- Total new field engineer hires, 1978	:	25
- Expected yearly headcount increase, 1979/83	:	20

- Systems Software training is provided by all of the mainframe manufacturers and third party maintenance companies, 60% of the small business system and terminal suppliers, and 75% of the minicomputer manufacturers. This normally consists of operating system and monitor/executive programs training and does not include application software. Utility (media, conversion and test programs) are covered also.

- Vendors largely create their own demand for maintenance training by:

  - the introduction of new technology within existing systems (mainframe memory is an example),

  - the introduction of new peripherals (disks and terminals were the main culprits mentioned),

  - the introduction of new systems (this is particularly relevant for the plug compatible equipment and minicomputer vendors where the rate of competitive announcements is constantly increasing).

- The second largest source of training requirements is the internal reassignment or transfer of field engineers from one group of products to another.

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- The third party maintenance companies are those that are most sensitive to the need for constant training (their people are their product), spending up to one month per year per engineer.

E. NEW HIRES AND SEPERATIONS

- The rate of hiring of new engineers, expressed as a percentage of the 1977 base total staff, varied in 1978 from 13% (for mainframe suppliers) to 26% (for small business/minicomputer vendors). Both of these percentages are inferior to the hiring rates experienced by the same equipment vendor categories in the U.S.

- However, the rate of engineer separations, for European mainframe vendors and small business/minicomputer suppliers alike, were also lower that their U.S. counterparts such that the net gain (in percentage terms) were comparable.

- The main reasons given for losing field engineers were quoted as:

  - "competitor poaching: there's a lot of minicomputer companies starting up",

  - "we're losing a lot of communications engineers to very big end-users, particularly banks",

  - "internal promotion: any vacancy inside the company is advertised internally and all can apply",

  - "other functions within the company, mainly marketing, technical support, systems design and software development",

  - "lack of career opportunities: the skill level required of field engineers is declining due to technological advances and higher levels of integration",

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EXHIBIT V-5

1978 NEW HIRES AND SEPARATIONS
OF FIELD ENGINEERS AS A PERCENTAGE
OF 1977 TOTAL FIELD ENGINEERS

TYPE OF VENDOR	NO. OF FIELD ENGINEERS 1977	NEW HIRES		SEPARATIONS	
		NO. IN 1978	% OF 1977 BASE	NO. IN 1978	% OF 1977 BASE
MAINFRAMES	5,768	749	13.0%	231	4.0%
SMALL BUSINESS MINICOMPUTERS	562	146	26.0	58	10.3
TERMINALS	527	90	17.1	37	7.0
THIRD PARTY MAINTENANCE	98	22	22.5	11	11.2
OTHER	225	43	19.1	14	6.2
ALL VENDORS COMBINED, EUROPE	7,180	1,050	14.6%	351	4.9%
ALL VENDORS COMBINED, U.S.	18,711	3,946	21.1%	1,902	10.2%

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- "boredom: lack of intellectual stretch",
- "competition: our engineers are highly trained and very versatile",
- "inflated salaries offered by small companies, particularly in the minicomputer field",
- "working conditions, unsociable hours and the liability to shift and on-call duties".

- The most volatile field engineer force in percentage terms, is found with the third party maintenance vendors (although the numbers are small and not necessarily significant); small computer and minicomputer vendors are also high in separations. Both show separations of the order of 11%.

- Equally, both the TPM and small business/minicomputer vendors have the highest hiring rates, of between 22 and 26%, which offset the losses they experience.

- In net hires, as a percentage of the existing mantenance staff, (i.e. percentage new hires minus percentage separations) the picture is as follows:

-	Mainframe	+ 9.0%
-	Small business/minicomputers	+15.7%
-	Terminals	+ 9.9%
-	Third Party Maintenance	+11.3%
-	Other	+12.9%

F. CURRENT MAINTENANCE ORGANIZATIONS

- The organizational structures currently in use for the management of the field engineer force has its impact on the ability of vendors to retain and properly motivate their engineers. In this respect, European vendor organisations have a higher ratio of managers and administrators to engineers than that found in the United States.

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EXHIBIT V-6

TOTAL RESPONDENT VENDORS'
MAINTENANCE ORGANIZATION
BY TYPE OF VENDOR

TYPE OF VENDOR/ NO. OF RESPONDENTS	FIELD ENGINEERS		FIELD MANAGERS		ADMINIS-TRATORS		TOTAL PERSONNEL	
	NO.	%	NO.	%	NO.	%	NO.	%
MAINFRAME	5,996	73.0%	1,396	17.0%	822	10.0%	8,214	100%
SMALL BUSINESS/ MINICOMPUTER	640	83.0	77	10.0	54	7.0	771	100
TERMINAL	589	66.0	89	10.0	214	24.0	892	100
THIRD PARTY MAINTENANCE	126	72.0	11	6.0	38	22.0	175	100
OTHER	258	72.0	25	7.0	75	21.0	358	100
TOTAL EUROPE	7,609	73.0%	1,598	15.4%	1,203	11.6%	10,410	100%
TOTAL U.S.	20,896	78.5%	2,168	8.1%	3,550	13.4%	26,614	100%

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- European vendors reported one field manager for every 4.76% engineers, (compared to one manager for 9.6 engineers in the U.S.) - a factor of almost two to one. (Note: supervisors are counted as managers in the European numbers).

- The imbalance is most evident in the mainframe vendors where 17% of the total maintenance personnel are supervisors/managers with 4.3 field engineers reporting to them on average. This is over twice the corresponding ratio found in the U.S., and results in complicated and top heavy structures (see V-G. FIELD MAINTENANCE CAREER PATH AND SALARIES).

- This is not the case of the small business/minicomputer vendors who have a low proportion of total maintenance personnel dedicated to both management (10%) and administration (7%).

- Terminal vendors reported the highest proportion of administration (24%) and the lowest proportion of field engineers (66%).

- Third party maintenance vendors reported the lowest proportion of field managers (6%) but this must be offset against the fact that many of these organizations are embryonic, cover only one country and usually manage the relatively small number of clients they have from the central headquarters.

G. FIELD MAINTENANCE CAREER PATH AND SALARIES

- The career path for the average field engineer is a tortured one, with all companies except the third party maintenance vendor. Between 8 and 10 levels of responsability are usually found between the junior engineer and the most senior Engineering Services Manager.

- This results in (i) the field engineers progressing more on seniority than on merit, i.e. losing their identity within the total field maintenance force, (ii) the gradual development of an inverse pyramid of age groups (the young, dynamic elements tend to leave, the older members find it more and more attractive to stay on).

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EXHIBIT V-7

RESPONDENT VENDOR HELD MAINTENANCE

SALARY STRUCTURES

TITLE/EQUIVALENT	AVE. SALARY RANGE $K /ANNUM	AVE.% OF TOTAL
. COUNTRY MANAGER	NOT GIVEN	N/A
. REGIONAL MANAGER	15.5 - 18.2	1
. BRANCH MANAGER	13.0 - 16.5	3
. TECHNICAL SUPPORT MANAGER	13.0 - 13.6	12
. SUPERVISOR/SENIOR PRINCIPAL ENGINEER	12.6 - 15.9	39
. INTERMEDIATE GRADES	10.7 - 13.6	15
. ENGINEER	9.8 - 11.3	21
. TRAINEE/JUNIOR/ASSOCIATE ENGINEER	7.8 - 9.1	9

Notes:

(i) excludes overtime, on-call allowances, "stress" money, unsocial hours, "dirty" money etc. which can be worth 30% more.

(ii) excludes third party maintenance vendors; for TPM going rates, add up to 60%, and allow a further 25 - 30% for supplementary allowances.

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- Salaries are undesirably low and inadequate for the key functions that the field engineer is expected to perform today. The additional duties he will be expected to perform in the future (e.g. full responsability for system software), will compound this problem.

- "Typical" salaries for "typical" grades do not exist. However, by groupng similar/equivalent titles, the basic salary structure presented in Exhibit V-7 can be constructed. The table excludes TPMs, who would otherwise distort the picture.

- TPM Vendor salary ranges lead the industry (and so they should with their emphasis on high performance, versatility and quality service). It is also a basic necessity if they are to attract the good quality (fully trained, mature) engineers they need and keep them once they have hired them.

- The salary structure in Exhibit V-7 is also evidence for the main problems mentioned by the vendors interviewed:

  - a glut of senior principal engineers (in seniority but not necessarily in skill),

  - a lack of junior level engineers,

  - too few managerial jobs to go around (which is regarded, rightly or wrongly, as the natural career path for the successful engineer).

- The result of these problems is reflected in the salary ranges; there is a narrow range of first level engineer salaries, followed by two stages of broader compensation ranges ("intermediate", "supervisor/senior") leading to a very narrow range for technical support managers (where it is no doubt felt that the status that comes with title has a value), followed by a small number of branch and regional managerial functions, where the salaries have to be competitive with the market's going rate.

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- A very active field engineer, working long hours can make a substantial salary with the enormous diversity of additional allowances that are available, (in addition to overtime). The principal of these is for being "on-call", (whether he is called or not).

- The salary scales provided by respondents show that they are more the result of an historical development than the result of a reasoned strategy of planned career progression, related to the skills that are needed. This is easier said than done, of course, (and a costly thing to modify when the multiplier at the key levels can be several hundreds, if not thousands).

- The most difficult aspect of field engineer manpower planning is that it is a long and arduous process to modify the skill content of the staff (either of those that are on board or of those that are planned for as new hires), particularly in relation to those product - or technology - related developments which are beginning to take place at an ever-increasing rate.

H. SPARE PARTS INVENTORY INVESTMENT REQUIREMENTS

- Spare parts investment, as a percentage of maintenance revenue and/or installed base at manufacturing cost was extremely difficult to determine from the European maintenance executives interviewed, since many:

  - had insufficient knowledge of the value of their spare parts inventory,
  - could only estimate the value of maintenance revenue since it was not separately identified within their company's financial analysis,
  - had no idea as to the precise composition of the installed base of products in existence, and little knowledge of its worth in end-user prices let alone the manufacturing cost of same.

- Consequently the values presents in Exhibit V-8 must be taken for what they are, namely "best available estimates" from the executives in charge of the maintenance fucntion of the various categories of companies and not accurate data based on reliable facts.

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EXHIBIT V-8

1978 AVERAGE SPARE PARTS INVESTMENT
AS A PERCENTAGE OF INSTALLED BASE (AT COST)
AND MAINTENANCE REVENUE BY TYPE OF VENDOR

TYPE OF VENDOR	PERCENTAGE OF INSTALLED BASE			PERCENTAGE OF MAINTENANCE REVENUE		
	HIGH	LOW	AVERAGE	HIGH	LOW	AVERAGE
MAINFRAME	5.0%	4.0%	4.6%	53.0%	30.0%	38.0%
SMALL BUSINESS/ MINICOMPUTER	6.0	3.0	3.7	20.0	15.0	17.3
TERMINAL	12.0	10.0	11.0	10.0	5.0	7.0
THIRD PARTY MAINTENANCE	-----NOT APPLICABLE-----			15.0	10.0	12.0
OTHER	3.8	3.8	3.8	10.0	10.0	10.0
ALL VENDORS COMBINED, EUROPE	6.7%	5.2%	5.8%	21.6%	14.0%	16.9%
ALL VENDORS COMBINED, U.S.	95.0%	0.7%	14.3%	80.0%	1.3%	32.1%

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- The results differ substantially from the data obtained in the U.S. study and are generally lower than the corresponding U.S. categories, with the exception of spare parts investment by the mainframe vendors, as a percentage of maintenance revenue. However, this is more the result of lower maintenance revenue than higher spare parts investment.

- If it can be accepted that maintenance charges are higher than those in the U.S. by the same margin as the prices charged for spare parts, then Exhibit V-8 suggest that European vendors, on average, hold spare parts inventories that are one half the level of those held in the U.S.

- Comments by many vendors on a growing practise of cannabalizing systems to provide urgent spares, and the common complaint of field engineers on the lack of availability of spares in general, support this assumption.

- This problem of lack of spares is compounded by the lack of adequate field repair depots, fault finding equipment and slow communications for the transit of deffective (or supposed deffective) units/boards from one location to another.

- As a result, the turnaround time for board repair is high. Added to the lack of new spares from production, this incites system cannabalization.

- Parts investment by part number is either done as part of the R & D directive or simply estimated by "best feel". Parts investment by dollar value is always estimated in this way ("feel").

- There is a general lack of reliable techniques for:

  - determining the spared requirements by relation to expected system sales, parts requirement by system and known/expected parts reliability,

  - computer modelling to project failure rates that can be expected from on-going data (which is usually not available).

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- Greater integration of function at board level is having two effects: a positive one, in that exchange of a board covers more possible source of failure than before; a negative one, in that board failure rates can increase, increasing the need for spares.

- Third party maintenance vendors excell in this area, by doing a per site study of the spares requirements according to the configurations to be supported, (whatever the mix of equipment) which guarantees the response rate to which they are committed. This ensures that speed of failure repair is independent of the equipment vendor, which is particularly important for mixed sites.

I. ON-SITE REPAIR LEVEL, COMPONENT/BOARD/UNIT

- It is a commonly accepted practice to replace only mechanical components on site (i.e. peripheral parts) with all other failures resulting in board replacement (other than extreme cases where sub-systems or systems need to be replaced).

- This results mainly from the fact that electronic component replacement is a skill that is increasingly specialized. Board costs have not yet decreased to the level where it is logical to replace them rather than the component, but there is no longer a practical alternative.

- Many vendors have recognized the growth of the need for decentralized board repair centres that handle "regional" requirements. This workshop concept is developing quickly with specialization of the functions performed at a workshop following rapidly behind.

- The board replacement concept is unlikely to change over the next five years, for the majority of the equipment installed. However, where economic trade-offs exist, vendors are offering meaningful alternatives.

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- In the case of terminals, it has long been the practice for the field engineer to replace the deffective unit with another, identical terminal, carrying the faulty one away for repair.

- In large terminal configurations, an economic alternative to the maintenance cost of guaranteed uptime is the addition of one or more redundant units which can be reconfigured into the system if a station fails.

J. ANALYSIS OF UTILIZATION OF MAINTENANCE MANPOWER

- This is an area where a good deal of improvement is required: whereas nearly all vendors knew their rate of trouble calls, none knew the rate of repeat calls (i.e. additional calls within a 2 week period for the same system) and many confessed they did not know the percentage of "no faults found".

- From the (incomplete) data provided, the following factors emerge:

  - calls per engineer ranged from a high of 18.3 per month (for a terminal manufacturer) to 8.0 per month (for a minicomputer vendor),

  - of these, "no fault found" were from 5% to 20% of calls, and 10% to 25% were repeat calls for the same system,

  - between 1% and 4% of engineer's time is dedicated to the implementation/installation of engineering change notices/field change orders.

- Third party maintenance vendors do not have an analysis that is exactly equivalent to this, since many of their engineers are dedicated to a single site and the user is encouraged to make use of them. In this context, "calls" and "repeat calls" do not have the same meaning.

- Vendors reported a growing backlog of ECNs, which is not being absorbed, and are having difficulty managing this requirement.

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- Half of those interviewed never bill for "no fault found" and the remainder bill sometimes (usually as deterrent for a customer becoming obnoxious) but don't always insist on payment (i.e. invoice is waived frequently).

- This is in partial contradiction to the accepted practice in the United States, where all companies submit an invoice if the customer makes a "no fault found" call outside of the contractually covered period. However, 52% of the vendors interviewed in the U.S. have eliminated billing for "no fault found" calls that occur within the contract cover period.

- Few of the vendors interviewed measure field engineer productivity at all. Those that do listed the following indices:

  - gross profit as a % of external revenue,
  - expense as a % of revenue,
  - no. of systems maintained,
  - sales value of equipment supported,
  - supported hours provided per field engineer,
  - cost of one hour of field engineering.

- As an assist in spreading the maintenance workload, nearly all vendors agree that customers should be asked to diagnose faults in his equipment. However, most thought that customers could not be asked to deliver faulty products to a maintenance depot for repair/replacement, with the exception of:

  - terminals,
  - CPU units for process control,
  - where clients have their own distribution/delivery service network (e.g. banks).

- Plans for the future in improving the service provided to users include:

  - on-line/remote diagnostics which allow real time monitoring of a systems reliability trend (in particular the logging of transient errors as well as "full stop" errors),

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- customer education to improve (i) their ability to perceive their true requirements more clearly (e.g. the definition of a minimum configuration) (ii) their comprehension of what is included in a maintenance contract and what is excluded (particularly for "contention" issues like using non-recommended media, misuse of equipment, environmental conditions exceeding acceptable limits, user modification of software etc),

- improving diagnostic aids so that on-site (visible) performance is improved and field engineer productivity rises,

- improve handling of spare parts inventories so that average physical distance between failed system and requried spare part is reduced,

- improve the reliability designed into the systems sold, including redundent components, circuits and elements where appropriate.

K. PRICING AND PACKAGING OF MAINTENANCE SERVICES

- Maintenance prices are usually jointly established by marketing and maintenance/customer services groups (although it must be questioned to what extent marketing understands the maintenance function and how well they know what the competition's rates cover in relation to the performance provided).

- The factors that respondent vendors listed as being taken into consideration vary widely, and range from global factors such as "competitive rates", "what the market will stand" etc, to more specific items such as:

  - profit planned (maintenance revenue can account for 30% of total company revenue),
  - geographical spread expected,
  - MTBF, MTTR,

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EXHIBIT V-9

1978 AVERAGE PERCENTAGE FOR ANNUAL MAINTENANCE CHARGES AS A PERCENT OF EQUIPMENT PURCHASE PRICE FOR RESPONDENT VENDORS

TYPE OF EQUIPMENT	HIGH %	LOW %	AVERAGE %
MAINFRAME	9.0%	3.5%	6.2%
SMALL BUSINESS COMPUTERS	10.0	8.7	9.4
MINICOMPUTER	12.0	8.8	10.1
TERMINAL	20.0	3.5	11.4
ALL VENDORS COMBINED, EUROPE	12.8%	6.1%	9.3%
ALL VENDORS COMBINED, U.S.	27.3%	5.0%	10.5%

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- estimate of spares holding,
- estimate of spares usage,
- total lifetime product population profile (rate of build/decrease),
- training costs (initial, replacement).

- To date software maintenance costs are excluded from this calculation but already some vendors have plans afoot to include the lifetime maintenance costs of system software into the maintenance rates.

- On average, yearly maintenance charges in Europe were reported as being 9.3% of the equipment purchase price, ranging from a high of 20% to a low of 3.5%. This means that over five years of life of a purchased system, the maintenance service produces a minimum of 46% of the revenue provided by the sale of the hardware, (see Exhibit V-9).

- One vendor, when asked what the average maintenance charge was for his company's hardware, reacted sharply: "it took me seven years to kill this idea! If you publish an average everybody wants to pay the average".

- Extended maintenance coverage charges are not consistent between vendors of the same category, or between categories. In fact no two vendors charge the same amount for the extra shift coverage described in Exhibit V-10. The percentages indicated relate to the one shift, five day charge.

- From the data provided, it appears that the cost of two extra Saturday shifts is, on average, almost as costly as 24 hour coverage during the week and that the third Saturday shift coverage costs an extra 25% of normal charges. The "high" and "low" percentage values show how wide the variance is on each shift/coverage between European vendors.

- "Time and material" service calls by respondent vendors were quoted, in many cases, as being variable rather than as a standard charge. Values of between $60 and $75 per hour of prime shift were given as guidelines, however it is not meaningful to chart the data received.

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EXHIBIT V-10

RATIO OF CHARGES FOR EXTENDED
MAINTENANCE COVERAGE BY
RESPONDENT VENDORS

MAINTENANCE COVERAGE	HIGH	LOW	AVERAGE
2 SHIFTS/5 DAYS	160%	125%	145%
3 SHIFTS/5 DAYS	200	135	170
2 SHIFTS/6 DAYS	190	140	165
3 SHIFTS/6 DAYS	240	150	195
3 SHIFTS/7 DAYS	----------	NOT GIVEN	----------

ONE SHIFT X 5 DAYS = 100% OF THE MAINTENANCE CONTRACT RATE

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- In terms of cost, the elements composing the average call have been broken out by major topic (see Exhibit V-11) and by vendor type. For labour costs, the average hourly rate was $15. Included in "labour" are the labour costs during travel, to and from a site.

- Travel costs are heavily dependent on the geographic coverage available from local support centres and the concentration/density of units being maintained. As a result the average mainframe and terminal travel cost per call is low while that of small business/minicomputer vendors is very high.

- Off setting this are the parts and material costs per call of mainframe manufacturers, which are very high, while those of terminal and small business/minicomputer vendors are low.

- Some vendors spread inventory depreciation costs (and other overheads) over the total volume of calls, (shown as "other" costs column) which distorts the total per call cost viz a viz those who do not.

- Control of these costs is key to making profit, since the revenue is "guaranteed", i.e. almost independent of the number of calls. Efficiency in reducing the number of calls is therefore very important and is being tackled by attempts to reduce repeat calls, diagnostic calls and "no fault found" calls through better problem definition, remote diagnostics and charging for "no fault found" (or putting the responsability for reproducing errors onto the user).

- In terms of the overall vendor maintenance costs, Exhibit V-12 breaks down the 1978/83 projected trends of the main cost elements:

  - field engineer costs are expected to rise and reach 58% of total costs by 1983; this is normal due to rising labour costs,

  - travel expenses also are expected to rise (which is surprising, since the advent of support centres should largely reduct this component),

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EXHIBIT V-11

AVERAGE MAINTENANCE SERVICE CALL
COST BUILDUP AS REPORTED
BY RESPONDENTS

VENDOR TYPE	COST BUILDUP				
	LABOR	TRAVEL	PARTS AND MATERIAL	OTHER	TOTAL
MAINFRAME MANUFACTURER	$ 90.40	$ 5.80	$110.20	$ 65.10	$271.50
SMALL BUSINESS/ MINICOMPUTER	72.80	44.80	56.00	-	173.60
TERMINAL	59.30	7.20	30.90	23.70	121.10
THIRD PARTY MAINTENANCE		-----NOT APPLICABLE-----			
OTHER	128.00	16.00	16.00	-	160.00
AVERAGE ALL VENDORS COMBINED	$ 87.60	$ 18.50	$ 53.30	$ 44.40	$203.00

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EXHIBIT V-12

RESPONDENT VENDORS'
MAINTENANCE COST BUILD-UP
FOR 1978 AND PROJECTED FOR 1983

COST FACTOR	1978 ACTUAL			1983 PROJECTED		
	HIGH	LOW	AVERAGE	HIGH	LOW	AVERAGE
FIELD ENGINEER	65%	26%	48.2%	66%	48%	58.0%
TRAVEL EXPENSES	10	5	7.9	11	5	9.3
OTHER DIRECT EXPENSES	16	2	9.9	15	10	12.5
MATERIALS	15	9	12.3	20	8	12.7
BURDEN	28	10	21.4	30	13	21.5
OTHER	24	2	9.8	2	2	2

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- "other direct expense" includes clerical support services, also expected to rise due to labour rates,

- materials (spare parts included) are expected to remain a constant proportion of the total cost, as is burden (or administrative overhead),

- "other" costs include marketing, H.Q. overhead (as opposed to country overhead, placed in "burden") and is not expected to vary.

L. MAINTENANCE REVENUE ANALYSIS

- The revenue produced by each engineer is an excellent yardstick of how efficient he is and a measure of the amount of hardware he can support. Obviously there is a great imbalance between this revenue-per-head value for mainframe vendors (who have the lion's share of the installed base), that for small business/minicomputer vendors and terminal vendors (whose products are far less costly), and that for the third party maintenance vendors who are half way between the two in the size of equipment maintained (they support a mixture of very large mainframes and small terminals or peripherals).

- Exhibit V-13 summarizes the vendor forecasts for the growth of their current per head revenue values, which reveal that:

  - mainframe vendors anticipate a stagnating growth of revenue per engineer, despite the planned introduction of new maintenance techniques and the creation of repair workshops and support centres,

  - small business/minicomputer vendors foresee the same problem, and terminal vendors anticipate a drop in revenue due to the current linking of maintenance charges to the equipment sales price (which is decreasing),

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EXHIBIT V-13

FORECAST OF AVERAGE MAINTENANCE
REVENUE PER FIELD ENGINEER FOR
RESPONDENT VENDORS BY TYPE OF VENDOR

TYPE OF VENDOR	AVERAGE MAINTENANCE REVENUE PER FIELD ENGINEER ($ THOUSAND)			
	1978	1980	1983	1978-1983 AAGR
MAINFRAME	$82.5	$84.2	$88.9	1.5%
SMALL BUSINESS/ MINICOMPUTER	23.3	24.2	25.7	2.0
TERMINAL	37.7	36.8	32.0	(3.2)
THIRD PARTY MAINTENANCE	42.9	42.2	41.9	(0.1)
OTHER	31.3	38.6	39.4	4.7
ALL VENDORS COMBINED, EUROPE	$43.5	$45.4	$45.6	1.0%
ALL VENDORS COMBINED, U.S.	$57.4	$57.8	$58.1	0.5%

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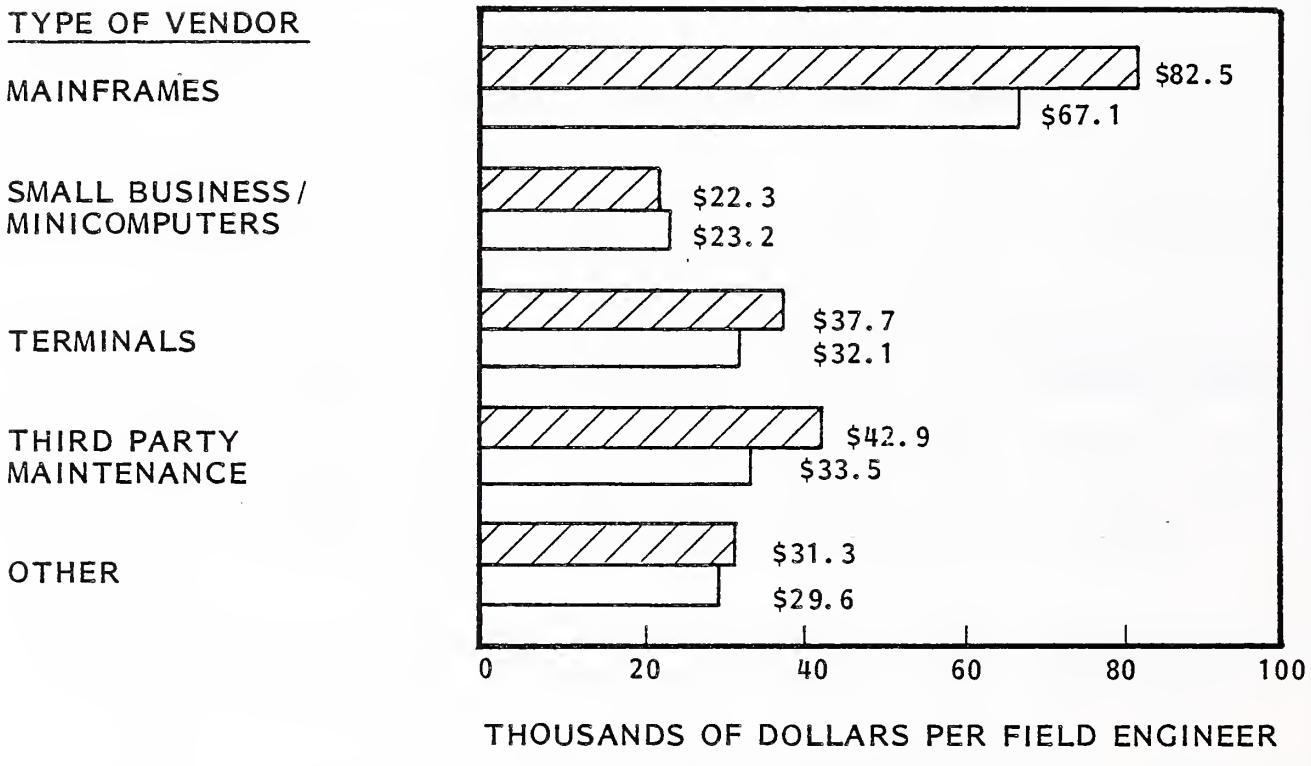
EXHIBIT V-14

REVENUE AND 1978 AVERAGE MAINTENANCE COST
PER FIELD ENGINEER FOR RESPONDENT VENDORS



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- third party maintenance vendors see their revenue per engineer declining for another reason: the current ratio is very high due to the very large user sites being maintained; site size will have to decrease as they expand their business.

- The overall growth of revenue is a small 1.0% over the five year period from 1978-1983. This will create pressure for finding ways of reducing maintenance costs, since (i) the maintenance function must be profitable in its own right (ii) current costs are largely based (52%) on items that will rise in value steadily (i.e. labour and travel).

- This situation is not unlike that found in the United States where the revenue per head values do not differ greatly from those found in Europe and the revenue growth rate is low.

- Revenues are compared to the costs experienced by each vendor category in Exhibit V-14. Of the vendors interviewed, only small business/minicomputer vendors are running their maintenance operations at a loss. The percentage pre-tax profit and loss found in the respondent vendors is summarized by category in Exhibit V-15.

- The percentage indicated must be seen in the light of the size of the maintenance revenues to which they apply:

  - the 18.7% average of the mainframe vendors represents a healthy business in its own right, given the size of their maintenance revenues,

  - the 4.0% loss of the small business/minicomputer vendors interviewed bodes ill for a business that is expanding so rapidly and must be brought under control,

  - third party maintenance vendors are enjoying a very high rate of profit but do not yet cover a significant percentage of the installed base of any of the equipment categories they service.

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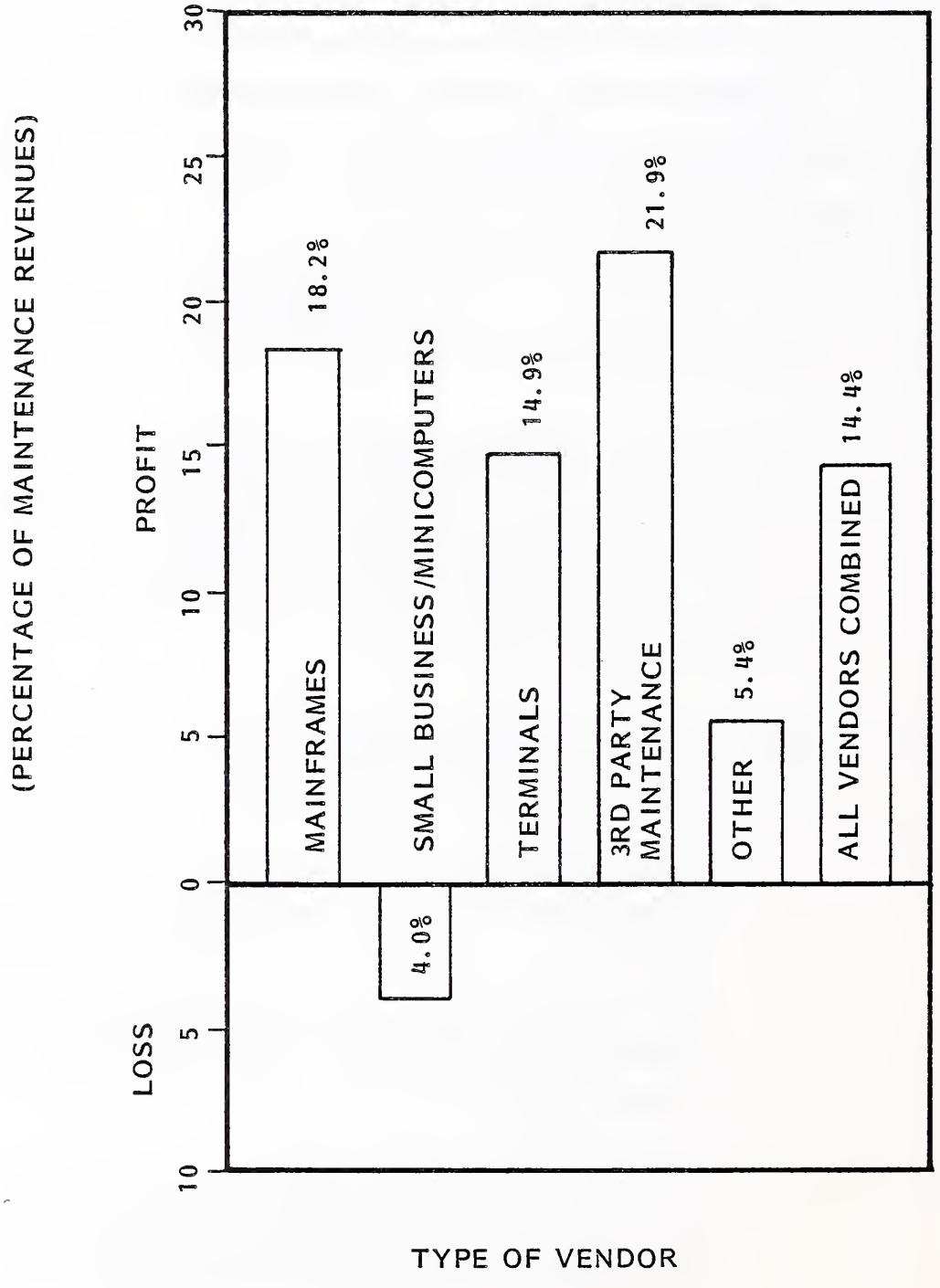
EXHIBIT V-15

RESPONDENT VENDORS' PERCENTAGE OF 1978 PRE-TAX PROFIT/LOSS AS A PERCENT OF MAINTENANCE REVENUES



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M. HARDWARE AND MAINTENANCE PERFORMANCE

- As one vendor put it: "the whole concept of maintenance and hardware performance has to be viewed with regard to the reliability the vendor is expected to achieve; this is a joint vendor/user decision; there is nothing wrong with defining a ystem for 50% uptime if that will do the job".

- This is a sensible approach if true cost affectiveness is to be achieved, since (i) different parts of a system require different levels of service (ii) not all user systems have the same critical performance levels (iii) the highest uptime and best service may be very expensive and are not always required.

- Thus while a very high MTBF makes sense to both vendor and user, a very high uptime may not if it is achieved by a costly maintenance coverage.

- With this in mind, Exhibit V-16 provides a matrix of the average vendor responses by category of equipment. Uptimes are high in all categories but the MTBF ranges vary substantially.

- Mean times to respond vary constantly also and must be carefully interpreted:

  - zero hours merely means that permanent on-site coverage is provided (and paid for by the user); this influences the "average" time and makes it look better than actual if the mean time to respond is taken as a measure of normal on-call services,

  - the high values for terminals must be seen in the light of the fact that this includes non-critical terminals (e.g. one terminal failing out of a configuration of 4, an event which delays throughput but does not halt operation of the system itself),

  - the minicomputer values probably indicate therefore, the least responsiveness service (and this is reflected in the average uptime percentage), and show the highest mean time to repair as well.

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EXHIBIT V-16

REPORTED HARDWARE AND MAINTENANCE PERFORMANCE OF RESPONDENT VENDORS

TYPE OF EQUIPMENT	PERCENTAGE UPTIME (%)			MEAN TIME BETWEEN FAILURES (HOURS)	MEAN TIME TO RESPOND (HOURS)			MEAN TIME TO REPAIR (HOURS)		
	HIGH	LOW	AVG.	RANGE	HIGH	LOW	AVG.	HIGH	LOW	AVG.
MAINFRAME	99.9%	95.1%	98.0%	75-2,000	5.0	0.0	1.2	5.9	0.0	2.7
SMALL BUSINESS COMPUTER	99.0	93.5	96.4	50-2,000	9.0	1.0	2.8	10.0	0.5	1.8
MINICOMPUTER	100.0	90.0	95.5	110-2,000	24.0	1.0	3.8	6.0	0.3	4.4
THIRD PARTY MAINTENANCE	99.9	96.0	98.0	300-600	NOT APPLICABLE			2.0	0.0	0.8
TERMINAL	100.0	98.0	99.0	1600-3000	24.0	1.0	8.0	2.0	0.3	1.0
OTHER	98.0	87.0	96.0	24-200	NOT GIVEN			25.0	1.0	4.0
ALL VENDORS COMBINED, EUROPE	99.4%	92.7%	97.0%	24-3000	15.5	0.75	3.95	8.5	0.3	2.5
ALL VENDORS COMBINED, U.S.	99.9%	88.0%	96.2%	10-12,000	24.0	0.5	3.27	8.0	0.5	1.9

INP

- The mainframe average MTBF is very good, considering the growing complexity of the configurations being serviced and the low level of redundant components in use in today's generation of computers.

- Compared to the maintenance and hardware service provided in the U.S., the overall average values for European vendors' MTBF, response and MTTR, show a slightly inferior performance but an equivalent uptime percentage.

N. VENDOR ATTITUDES TOWARD MAINTENANCE CHARACTERISTICS

- In terms of the vendors' perception of the importance to users of field maintenance characteristics, Exhibit V-17 summarizes the data provided by respondent companies.

- European vendors, like their U.S. counterparts, were unanimous in identifying mean time to respond as the main requirement in the users' eyes followed by mean time to repair.

- Least important of all was account management, with only one vendor rating it highly. In this regard, one vendor commented: "we tend to be more field engineering oriented, rather than customer engineering oriented, where the emphasis is primarily on a happy client rather than a system in good order".

- In several instances the vendor has a contractual obligation to fulfill, with regard to mean time to respond, which gave weight to the response to this factor. Other vendors feel that mean time to respond is the maintenance factor that impresses the user most.

- Mean time to repair is also important. A vendor commented: "90% of our small systems faults are fixed withn an hour or reporting, including travel time".

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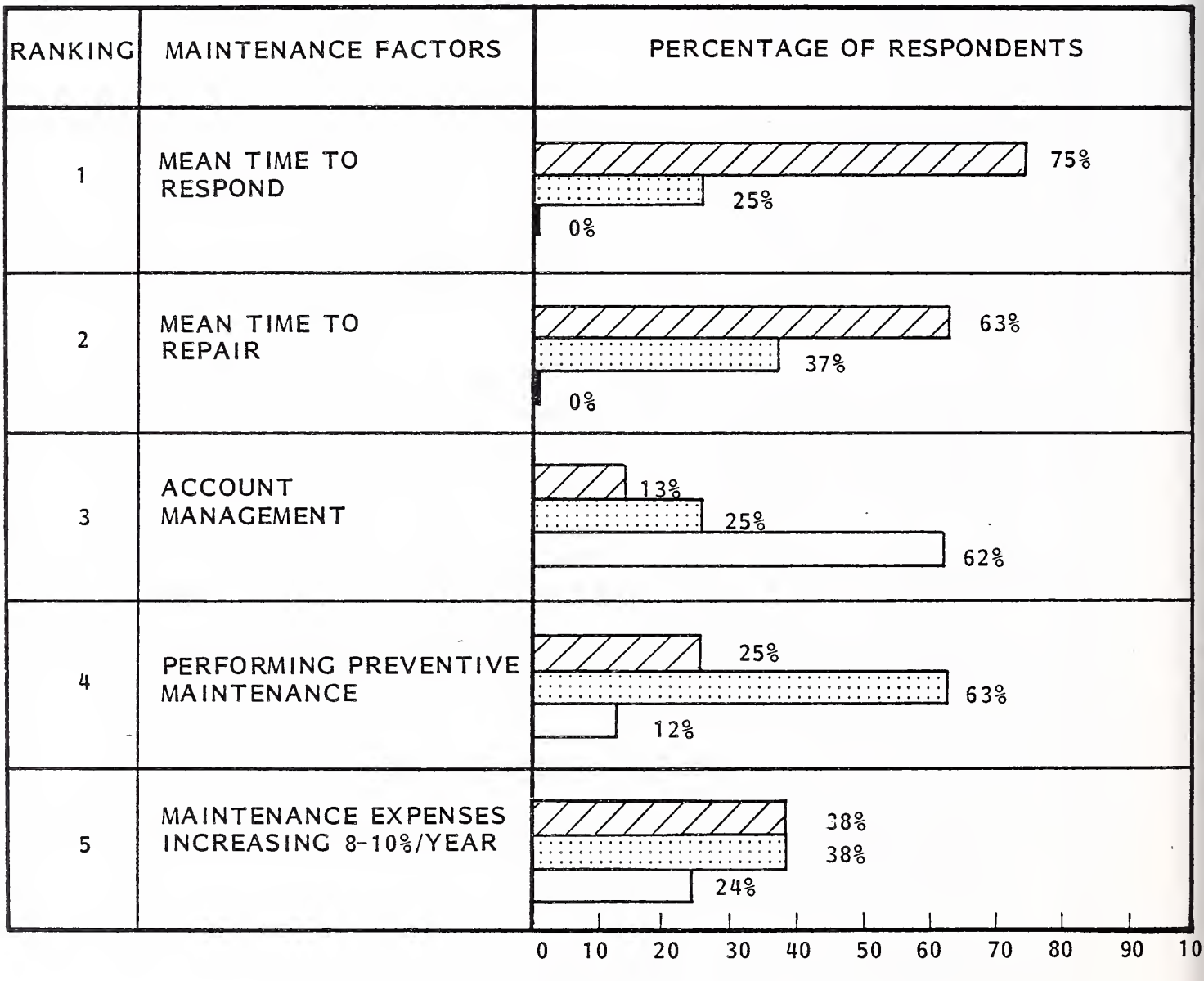
EXHIBIT V-17

RESPONDENT VENDORS' RATING OF THE IMPORTANCE TO USERS OF VARIOUS FIELD MAINTENANCE FACTORS



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- The next most important factor mentioned was the increase in maintenance costs to users, where a lot of vendors are coming under pressure from users to check or even reduce current maintenance costs. However, there are groups of users who are not concerned, particularly Universities.

- Performing preventive maintenance is, again, a contractual obligation in some sectors of business (e.g. Government and public corporations): "there is frequently a person designated in some Government offices who monitors that it is done".

- Other factors mentioned as important included:

  - tele-(remote) diagnostics: "this has great image/user satisfaction potential because they feel we are always available",

  - second line technical back-up: "failure to fix something on-site is only disastrous it their is no organised escalation procedure".

- The respondent vendors' evaluation of their own performance compared to what they believe about competition was informative:

  - most felt that there could be significant improvement in satisfying their maintenance staff's satisfaction with their job, the career prospects open to them and the salaries they earn; as a result few vendors rated their personnel turnover as anything more than average compared to the competition (who usually feels the same way),

  - a similar consensus of opinion was reached on their ability to respond to calls rapidly: nearly all felt that their meantime to respond was excellent,

  - mean time to repair values were not rated high; again an "average" performance was claimed by most vendors,

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EXHIBIT V-18

RESPONDENT VENDORS' RATING OF THE IMPACT OF FUTURE DEVELOPMENTS ON MAINTENANCE TECHNIQUES

FUTURE DEVELOPMENTS	*RATING PERCENT					RANKING
	1	2	3	4	5	
RISING LABOR COSTS	-	-	-	17	83	1
INCREASING PRODUCT PRICE/PERFORMANCE	-	-	17	50	33	2
USER PERFORMING OWN MAINTENANCE	-	67	33	-	-	7
VENDOR AND USER COOPERATIVELY TEST EQUIP.	17	33	17	-	-	8
HOME OR PERSONAL COMPUTERS	50	-	-	-	-	10
MULTI-FUNCTION EQUIPMENT	33	17	-	-	-	9
BUILT-IN DIAGNOSTICS	17	17	33	17	-	5
REMOTE DIAGNOSTICS	17	17	17	33	-	4
DISTRIBUTED DATA PROCESSING	17	17	-	33	-	6
ADVANCES IN TECHNOLOGY	-	-	33	17	17	3

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- meantime between failure on their equipment was nearly always rated low: only one vendor claimed to better than all other vendors,

- total customer satisfaction was invariably rated high; despite admitting to low MTBF or slow meantime to respond/repair etc., each vendor feels there is enough understanding between him and his clients for the customer to be nevertheless satisfied with his equipment's performance.

- Overall the attitude of vendors is one of self criticism for those aspects of performance seen as internal or non-visible (personnel turnover, meantime to repair) and generally confident about the visible aspects of their service (how quickly they respond, the customer's overall satisfaction).

O. IMPACT OF FUTURE DEVELOPMENTS ON MAINTENANCE

- In assessing the future trend of the field maintenance function, vendors were asked to rate ten developments which were seen as influencing their ability to provide a profitable, responsive service to a changing user requirement. Exhibit V-18 summarizes the results.

- Uppermost in all minds are the rising labour costs for field and corporate/administrative staff, making their profit margins look vulnerable, particularly in view of growing user pressure for vendors to stabilize maintenance costs. Tools must be sought to increase productivity and efficiency while limiting non-labour costs, to maintain adequate margins.

- Second most important factor is the rapidly changing ratio of performance to price, the one rising the other decreasing. Both put pressure on the maintenance service and imply technology changes (rated third most important factor) that will mean a change in the mix of capabilities available within today's maintenance force.

- Several tools for improving productivity of the maintenance field force were also quoted high on the rating list:

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- remote diagnostics to enable trouble shooting to be carried out from central maintenance/customer service centres, which allow team handling of failure diagnostic, if necessary, without increasing costs dramatically,

- built in diagnostics, which allow the user to take an active part in determining the source of the failure before calling for help (and/or carrying out a certain level of remedial maintenance himself with board replacements, where relevant),

- user performing own maintenance was separately identified as being a desirable development (but this, and vendor and users co-operatively testing the failed equipment, were quoted as having far less impact in the near future than the former two points).

- Distributed data processing causes concern in that, like the proliferation of small business computers and minicomputers, it mean a further geographical dispersal of the units to be maintained. There is no evidence that vendors have made provision for maintaining the growing proportion of systems sold in this environment. Remote diagnostics, so far, are only aimed at large sites.

P. PROBLEMS IN VENDOR MAINTENANCE ORGANIZATIONS

- Within their own maintenance operations, vendors have a number of key current problems to address, irrespective of the future trends discussed above. These are presented in Exhibit V-19.

- Foremost in a majority of organizations interviewed, (and consistent with earlier discussions), is the problem of training field maintenance staff. This applies mainly to the requirement of continual reporting of existing field engineers in the needs of new products, new technologies being implemented, new designs used, the procesures which are being devised to maximize their efficiency and the growing system software maintenance load they are expected to shoulder.

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EXHIBIT V-19

RESPONDENT VENDORS' RATING OF THE IMPORTANCE OF PROBLEMS IN THEIR ORGANIZATIONS

PROBLEM	% OF RESPONSES-RATING					RANK
	5	4	3	2	1	
MORALE OF THE MAINTENANCE FORCE	13	-	25	38	-	5
RECRUITING FIELD MAINTENANCE PERSONNEL	13	13	25	-	25	4
TRAINING FIELD MAINTENANCE PERSONNEL	38	13	-	13	25	1
REDUCING LABOR TURNOVER	-	-	-	25	38	11
PRODUCT QUALITY	27	13	13	13	13	3
ADEQUATE DIAGNOSTIC EQUIPMENT	25	25	13	13	-	2
ADEQUATE REMOTE DIANOSTIC ASSISTANCE	-	-	25	25	13	8
MARKETING DEMANDS	-	-	25	13	25	9
CUSTOMER DEMANDS	-	-	13	25	25	10
BUDGET LIMITS	-	13	-	13	13	7
SALARY ADMINISTRATION	-	13	-	13	25	6

5 = HIGHEST PRIORITY

1 = LOWEST PRIORITY

- Adequate diagnostic equipment, (an efficiency/productivity issue), was rated by respondent vendors as the second most important problem, marginally ahead of product quality (which is still viewed by all vendors as capable of significant improvement).

- This means that few vendors anticipate being able to drastically improve reliability through product quality (even the introduction of the perfect product would have little immediate effect on the maintenance workload which is the result of the installed base of existing products) but expect a continuation in the trend of gradual improvement in product performance that most have experienced over the past five years.

- Recruiting new staff is an important issue: the current boom in sales all vendors have experienced is expected to continue, creating maintenance service demands that cannot be handled by existing staff. However, the numbers sought are small (there are no vendors seeking to increase staff by as much as 10%, other than third party maintenance organisations).

- The morale of the field engineer, his salary conditions and career path need are recognised as needing to be attented to, and his status in the company brought in line with his contribution to the success of the business.

- Of less importance are reducing labour turnover (which is not a problem in Europe), customer demands, marketing demands and the availability of adequate remote diagnostic equipment (which, while it has its usefulness as a productivity tool, does not solve a vendors' internal organization problems).

Q. VENDOR ATTITUDES TOWARDS THIRD PARTY MAINTENANCE

- Two elements are involved in this topic:

  - do equipment vendors presently use third party maintenance service and, if not, would they consider it,

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- do they themselves offer, or would they consider offering, third party maintenance services to other manufacturers' products.

- On the first point, several equipment manufacturers already use TPM services, for:

  - small markets that are not seen as growth areas,
  - obsolete equipment,
  - mixed peripheral configurations on CPUs they themselves maintain (usually minicomputers),
  - terminal manufacturers' equipment,
  - certain special function peripherals, not available in their own catalogues.

  To these instances must be added the classical TPM take over of entire user sites, where the vendor has no choice (equipment is purchased).

- Those that do not use third party servcies but who would consider it, cited as reasons for examining TPM:

  (i) country markets where currency movement is restricted,

  (ii) country markets where the equipment manufacturer is not permitted to trade,

  (iii) country markets where the equipment manufacturer is not established.

  None of these reasons look particularly enticing business opportunities for the TPM vendor, unless he happens to be, say, Spanish (for (i)), trading in India (for (ii)) or supporting a U.S. manufacturer in Europe (or vice versa) for (iii).

- On the question of equipment vendors being willing to offer TPM services for products other than their own, nearly all respondent vendors said "yes". This seems to be wishful thinking, however, since:

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- they all admit to being saturated as to maintenance service capability with their own products,
- their "own product" workload is steadily increasing with no end to growth in sight,
- all have difficulties in finding, hiring, training and retaining the new recruits they already require.

- In addition, a successful TPM service requires an entirely different set of management attitudes to those found in the maintenance organizations of the European equipment manufacturers. It is unlikely that existing vendors could easily adapt to these, although market entry does not appear to pose any major problems.

- A logical extension of the TPM service is the offering of systems and applications software products, (particularly systems software). At present, however, the average European (or Europe-based) TPM vendor is too pre-occupied with the growth of the client base for hardware services to be interested in (or capable of) expanding into a second dimension market like software.

R. SALE OF MAINTENANCE CONTRACTS

- In general terms, there is no "sale", as such, of basic maintenance services, they are a de facto extension of the sale of the equipment. However, most vendors have begun to review this approach in the light of:

  - increased maintenance costs,
  - the need to tailor maintenance services to a particular user's requirement,
  - encroachment from TPM vendors.

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- As a result, while the basic maintenance service is sold as an inclusive part of the sale/rent of equipment, extended engineering coverage is handled by a maintenance representative. Normally no commission is paid for this (there are isolated cases only) but frequently a bonus kitty is established, providing benefits in kind (e.g. maintenance staff "conferences", with wives).

- The same commission kitty approach is used for the sale, by maintenance staff, of other hardware products in particular but also for the sale of supplies (tape reels, disks etc).

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APPENDIX A: DEFINITIONS

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APPENDIX A: DEFINITIONS

DISTRIBUTED DATA PROCESSING - Distributed processing is the deployment of programmable intelligence in order to perform data processing functions where they can be accomplished most effectively, through the electronic interconnection of computers and terminals, arranged in a telecommunications network adapted to the user's characteristics.

ENGINEERING CHANGE NOTICE (ECN) - Product changes to improve the product after it has been released to production.

ENGINEERING CHANGE ORDER (ECO) - The follow-up to ECNs which include parts and a bill of material to affect the change in hardware.

FIELD ENGINEER (FE) - For the purpose of this study, field engineer, customer engineer, serviceman, and maintenance man were used inter-exchangeably and refer to the individual who responds to a user's service call to repair a device or system.

MEAN TIME TO RESPOND - The elapsed time between the user placement of a service call and the arrival at the user's location of a field engineer.

MEAN TIME TO REPAIR - The elapsed time from the arrival of the field engineer on the user's site until the device is repaired and returned to the user for his utilization.

MEAN TIME BETWEEN FAILURES (MTBF) - The elapsed time between hard failures on a device or a system.

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APPENDIX B: SUPPORTING CHARTS

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EXHIBIT B-1

DISTRIBUTION OF INFORMATION PROCESSING EXPENSES BY EXPENSE CLASSIFICATION, AS FORECASTED BY RESPONDENTS (1979 - 1983)

U.K.

CLASSIFICATION	1979	1980	1983	AAGR
MEDIUM/LARGE SYSTEMS AND MINI/SMALL BUSINESS COMPUTERS	£10.378 M	£11.754 M	£15.757 M	11%
TERMINALS	.999 M	1.186 M	1.681 M	13.8%
DATA COMMUNICATIONS	.453 M	.968 M	1.421 M	33%
PERSONNEL	12.585 M	14.075 M	21.086 M	13.7%
MAINTENANCE	1.007 M	2.962 M	4.071 M	41.7%
TOTAL	£25.422 M	£30.945 M	£44.016 M	14.7%

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EXHIBIT B-2

DISTRIBUTION OF INFORMATION PROCESSING EXPENSES, BY EXPENSE CLASSIFICATION, AS FORECASTED BY RESPONDENTS (1979 - 1983)
HOLLAND

CLASSIFICATION	1979	1980	1983	AAGR 1979-1983
MEDIUM/LARGE SYSTEMS AND MINI/SMALL BUSINESS COMPUTERS	FL 7.72M	FL 7.86M	FL 11.16M	9.7%
TERMINALS	FL 3.17M	FL 4.59M	FL 8.32M	27%
DATA COMMUNICATIONS	FL 1.97M	FL 3.25M	FL 7.1M	38%
PERSONNEL	FL 8.67M	FL 8.67M	FL 12.1M	8.7%
MAINTENANCE	FL 1.81M	FL 1.51M	FL 1.2M	-10%
OTHER	FL 3.02M	FL 1.86M	FL 0.3M	-44%
*TOTAL	FL 26.36M	FL 27.74M	FL 40.2M	11%

(*TOTAL FIGURES ARE LOWER THAN THOSE ON EXHIBIT 2 DUE TO 4 RESPONDENTS NOT STATING THEIR DISTRIBUTION OF EXPENSES.)

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EXHIBIT B-3

RESPONDENT USERS ANTICIPATED PERCENTAGE
OF MAINTENANCE INCREASES IN 1980 VS 1979
BY COMPANY SIZE
U.K.

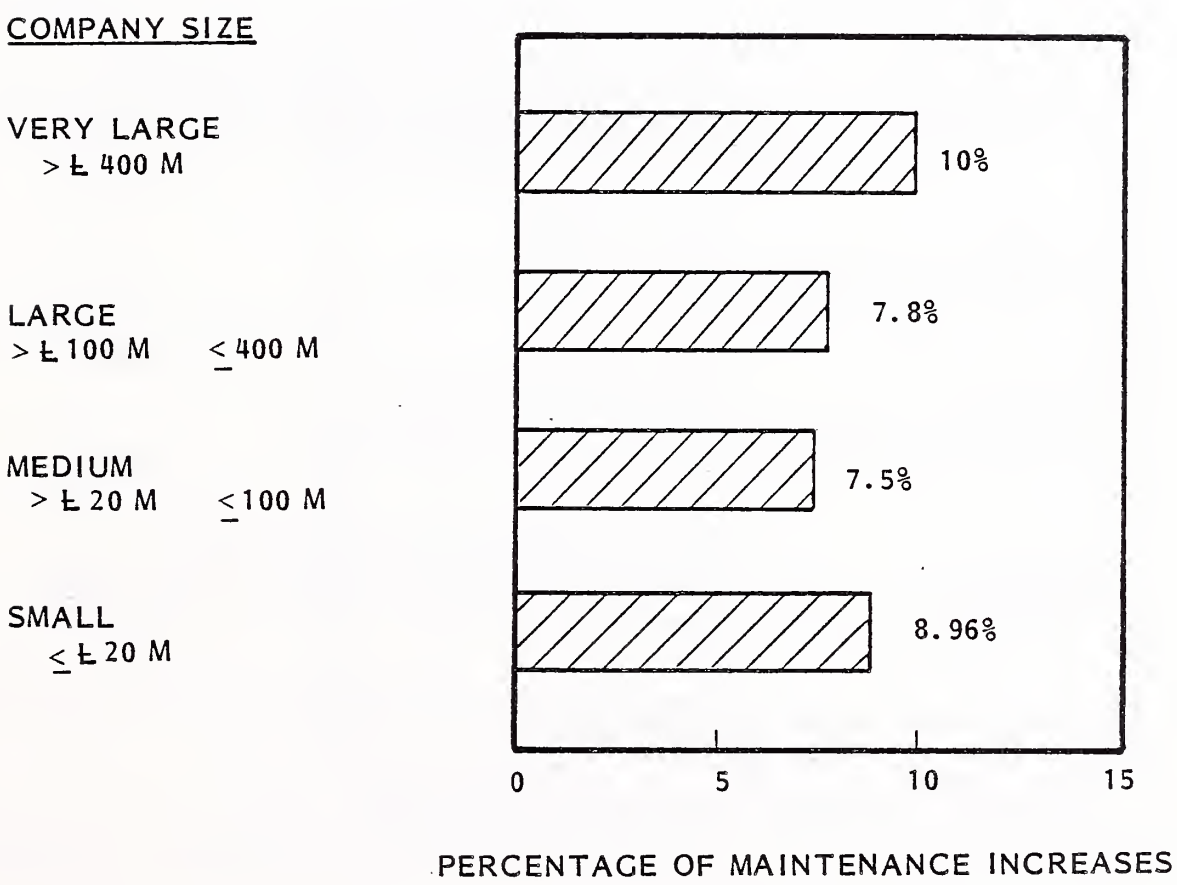

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EXHIBIT B-4

RESPONDENT USERS' ANTICIPATED PERCENTAGE OF MAINTENANCE COST INCREASES IN 1980 VS. 1979 BY COMPANY SIZE WEST GERMANY

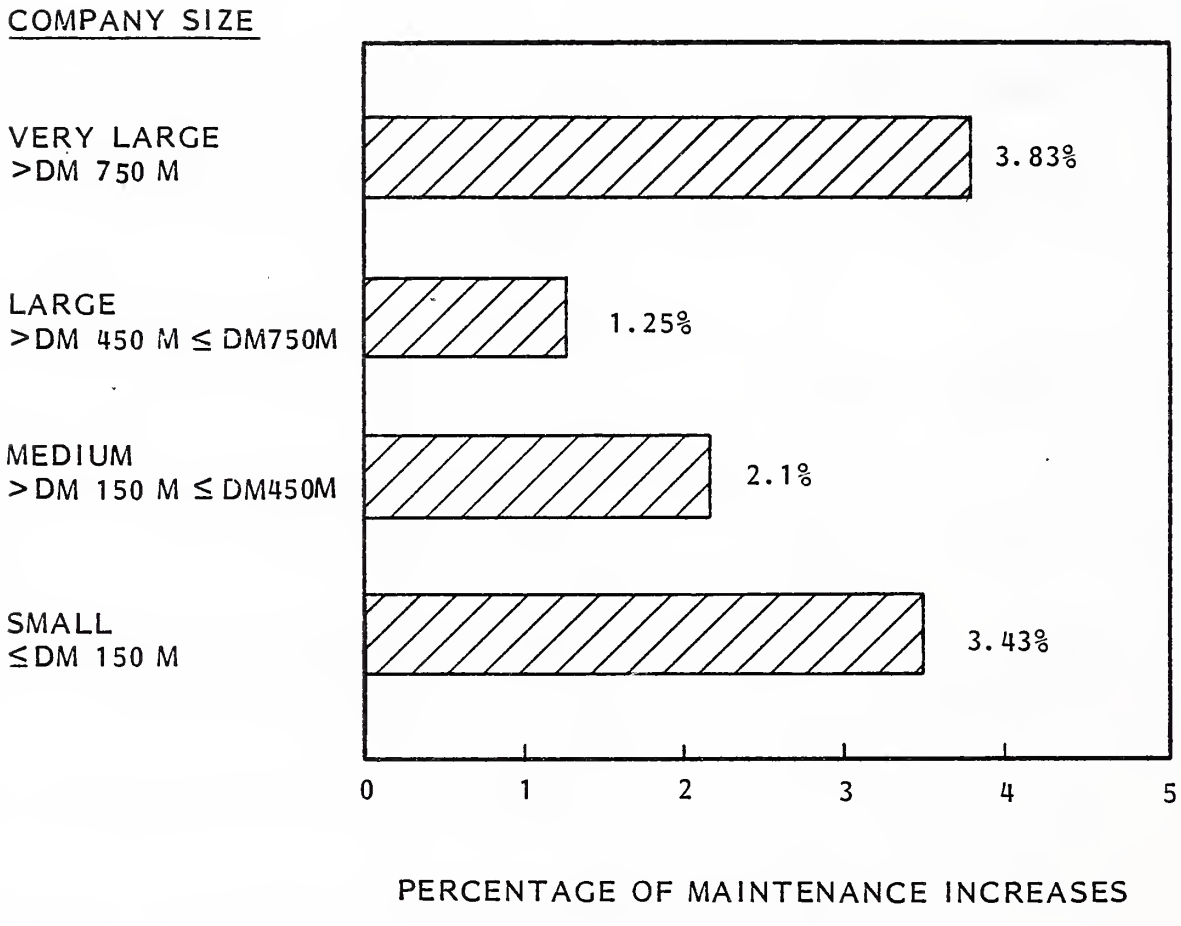

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EXHIBIT B-5

RESPONDENT USERS' ANTICIPATED PERCENTAGE
OF MAINTENANCE INCREASES IN 1980 VS 1979 BY COMPANY SIZE
HOLLAND

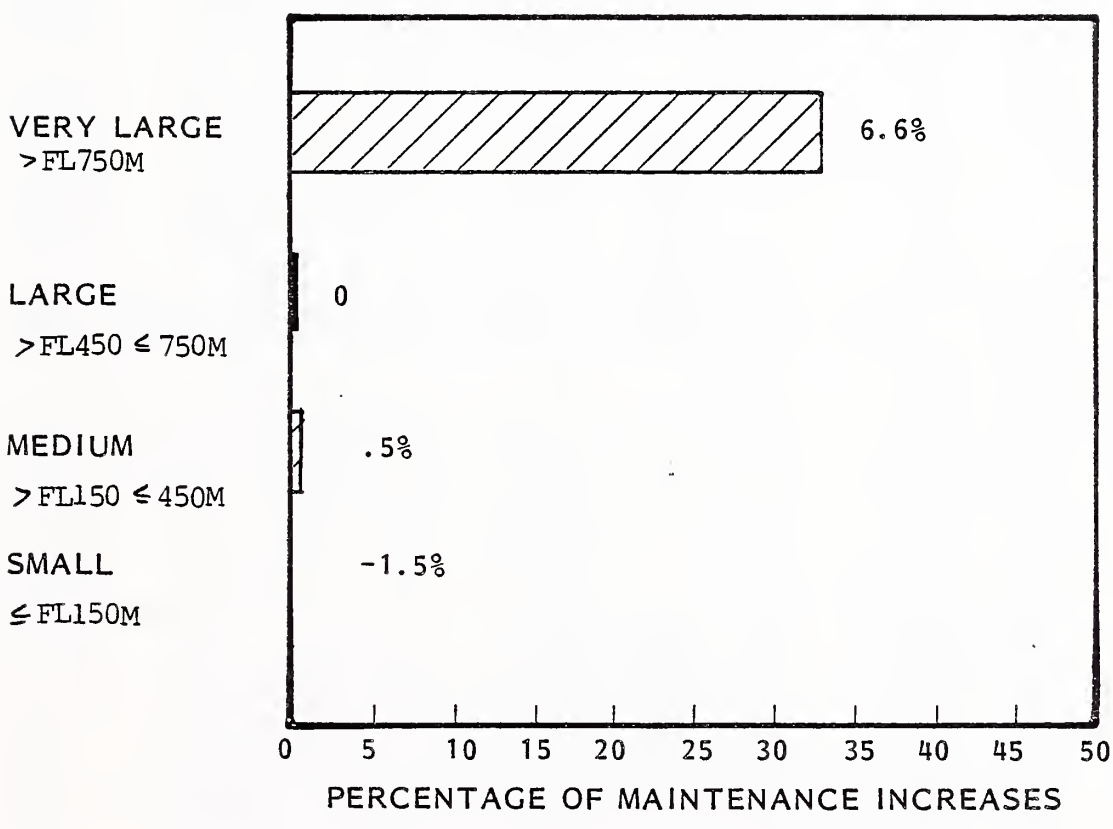

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EXHIBIT B-6

RESPONDENT USERS ACTUALLY OR POTENTIALLY

PERFORMING MAINTENANCE TASKS, BY COMPANY SIZE

U.K.

TASK	PRESENTLY PERFORMING				TOTAL	WOULD CONSIDER PERFORMING				TOTAL	PERCENTAGE PRESENTLY OR POTENTIALLY PERFORMING					PERCENT
	VL	L	M	S		VL	L	M	S		VL	L	M	S	TOTAL	
INSTALLING EQUIPMENT	0	3	4	5	12	1	3	6	4	14	10%	30%	48%	39%	26	36%
RUNNING DIAGNOSTICS	7	11	6	7	31	3	9	12	4	28	100	95	85	48	59	82
PERFORMING MAINTENANCE	0	0	1	2	3	3	6	3	5	17	33	30	14	22	20	28
DELIVERING FAULTY EQUIPMENT FOR REPAIR	0	1	0	2	3	0	4	3	2	9	0%	25%	14%	17%	12	17%

NUMBER OF RESPONDENTS: 72

INPU

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EXHIBIT B-7

RESPONDENT USERS ACTUALLY OR POTENTIALLY PERFORMING
MAINTENANCE TASKS, BY COMPANY SIZE
WEST GERMANY

TASK	PRESENTLY PERFORMING				TOTAL	WOULD CONSIDER PERFORMING				TOTAL	PERCENTAGE PRESENTLY OR POTENTIALLY PERFORMING					PERCENT
	VL	L	M	S		VL	L	M	S		VL	L	M	S	TOTAL	
INSTALLING EQUIPMENT	1	2	1	1	5	1	0	0	0	1	40	22	8	8	6	15%
RUNNING DIAGNOSTICS	3	5	8	9	25	0	0	0	2	2	60	56	66	85	27	69%
PERFORMING MAINTENANCE	0	0	1	0	1	0	0	0	0	0	0	0	8	0	1	3 %
DELIVERING FAULTY EQUIPMENT FOR REPAIR	0	0	0	0	0	1	0	1	0	2	20	0	8	0	2	5%

VERY LARGE=VL
LARGE =L
MEDIUM =M
SMALL =S

1521-17

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EXHIBIT B-8

RESPONDENT USERS ACTUALLY OR POTENTIALLY PERFORMING
MAINTENANCE TASKS, BY COMPANY SIZE
HOLLAND

TASK	PRESENTLY PERFORMING				TOTAL	WOULD CONSIDER PERFORMING				TOTAL	PERCENTAGE PRESENTLY OR POTENTIALLY PERFORMING					PERCENT
	VL	L	M	S		VL	L	M	S		VL	L	M	S	TOTAL	
INSTALLING EQUIPMENT	1	-	-	-	1	1	-	-	-	1	50	-	-	-	2	12%
RUNNING DIAGNOSTICS	1	1	-	1	3	1	1	2	2	6	50	67	40	40	9	53%
PERFORMING MAINTENANCE	-	-	-	-	-	-	1	1	2	4	0	33	20	40	4	24%
DELIVERING FAULTY EQUIPMENT FOR REPAIR	-	-	-	-	0	1	-	-	1	2	-	-	-	20	2	12%

VERY LARGE=VL
LARGE =L
MEDIUM =M
SMALL =S

NUMBER OF RESPONDENTS-15

EXHIBIT B-9

RESPONDENT USERS' MAINTENANCE
COVERAGE REQUIREMENTS
U.K.

MAINTENANCE COVERAGE	VERY LARGE	LARGE	MEDIUM	SMALL	TOTAL RE-SPONSES	PERCENT OF TOTAL
ONE SHIFT/FIVE DAYS	2	2	8	4	16	26%
ONE SHIFT/SIX DAYS	0	0	0	0	0	0
ONE SHIFT/SEVEN DAYS	0	0	0	0	0	0
TWO SHIFTS/FIVE DAYS	1	4	10	3	18	29
TWO SHIFTS/SIX DAYS	0	1	0	1	2	3
TWO SHIFTS SEVEN DAYS	1	0	2	0	3	5
THREE SHIFTS/FIVE DAYS	2	6	4	1	13	21
THREE SHIFTS/SIX DAYS	0	0	0	1	1	2
THREE SHIFTS/SEVEN DAYS	3	2	1	3	9	15
TOTAL RESPONSES	9	15	25	13	62	100%

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EXHIBIT B-10

RESPONDENT USERS' MAINTENANCE
COVERAGE REQUIREMENTS
WEST GERMANY

MAINTENANCE COVERAGE	VERY LARGE	LARGE	MEDIUM	SMALL	TOTAL RE-SPONSES	PERCENT OF TOTAL
ONE SHIFT/FIVE DAYS	1	2	3	5	11	28%
ONE SHIFT/SIX DAYS	0	1	0	0	1	3%
ONE SHIFT/SEVEN DAYS	0	0	0	1	1	3%
TWO SHIFTS/FIVE DAYS	1	2	6	1	10	26%
TWO SHIFTS/SIX DAYS	0	1	1	3	5	13%
TWO SHIFTS/SEVEN DAYS	0	0	0	1	1	3%
THREE SHIFTS/FIVE DAYS	3	1	2	1	7	18%
THREE SHIFTS/SIX DAYS	0	2	0	0	2	5%
THREE SHIFTS/SEVEN DAYS	0	0	0	1	1	3%
TOTAL RESPONSES	5	9	12	13	39	100%

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EXHIBIT B-11

RESPONDENT USERS' PERCEPTION OF
MEANS TO IMPROVE SERVICE
WEST GERMANY

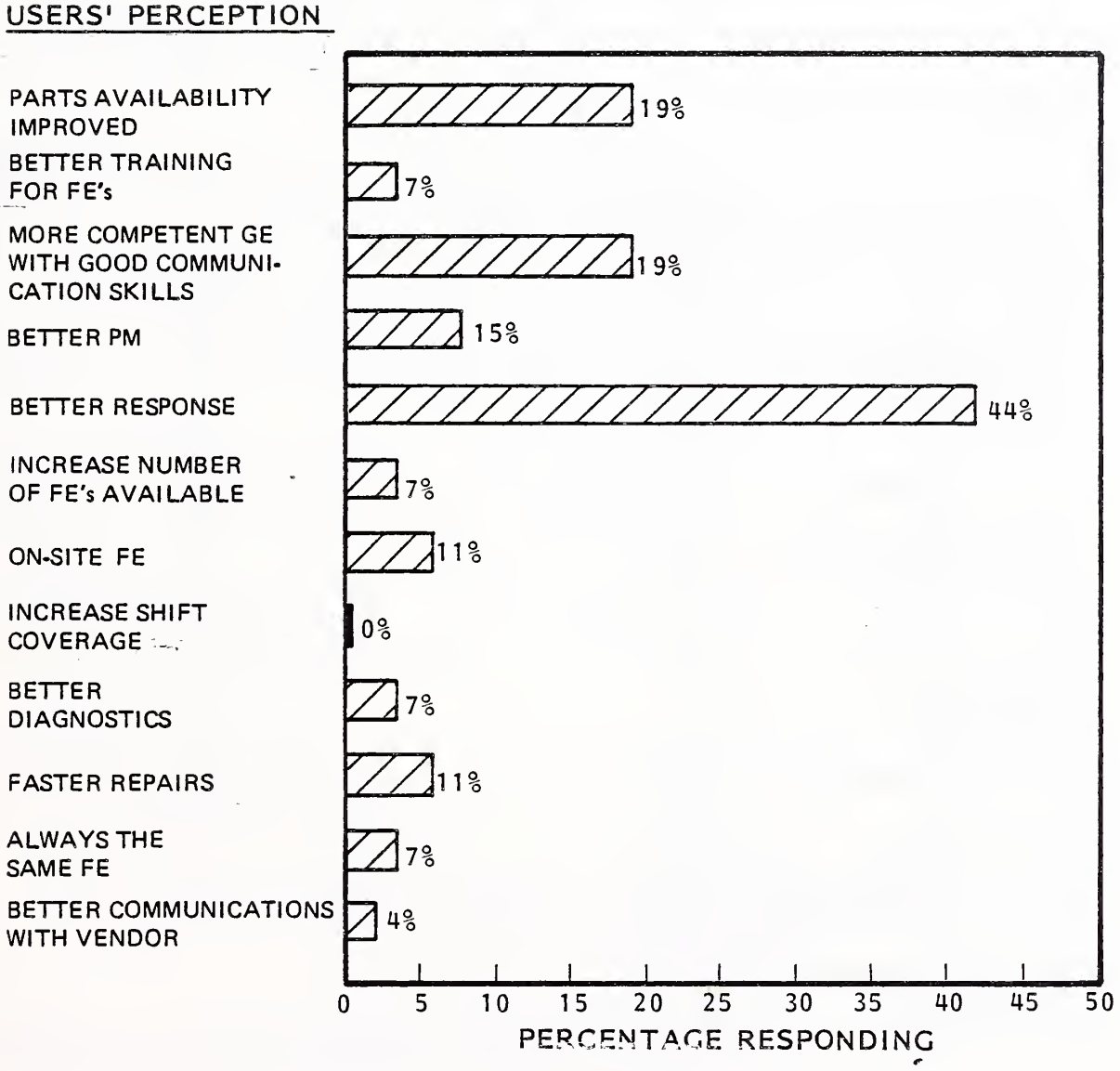

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EXHIBIT B-12

RESPONDENT USERS' PERCEPTION

OF MEANS TO IMPROVE SERVICE

U.K.

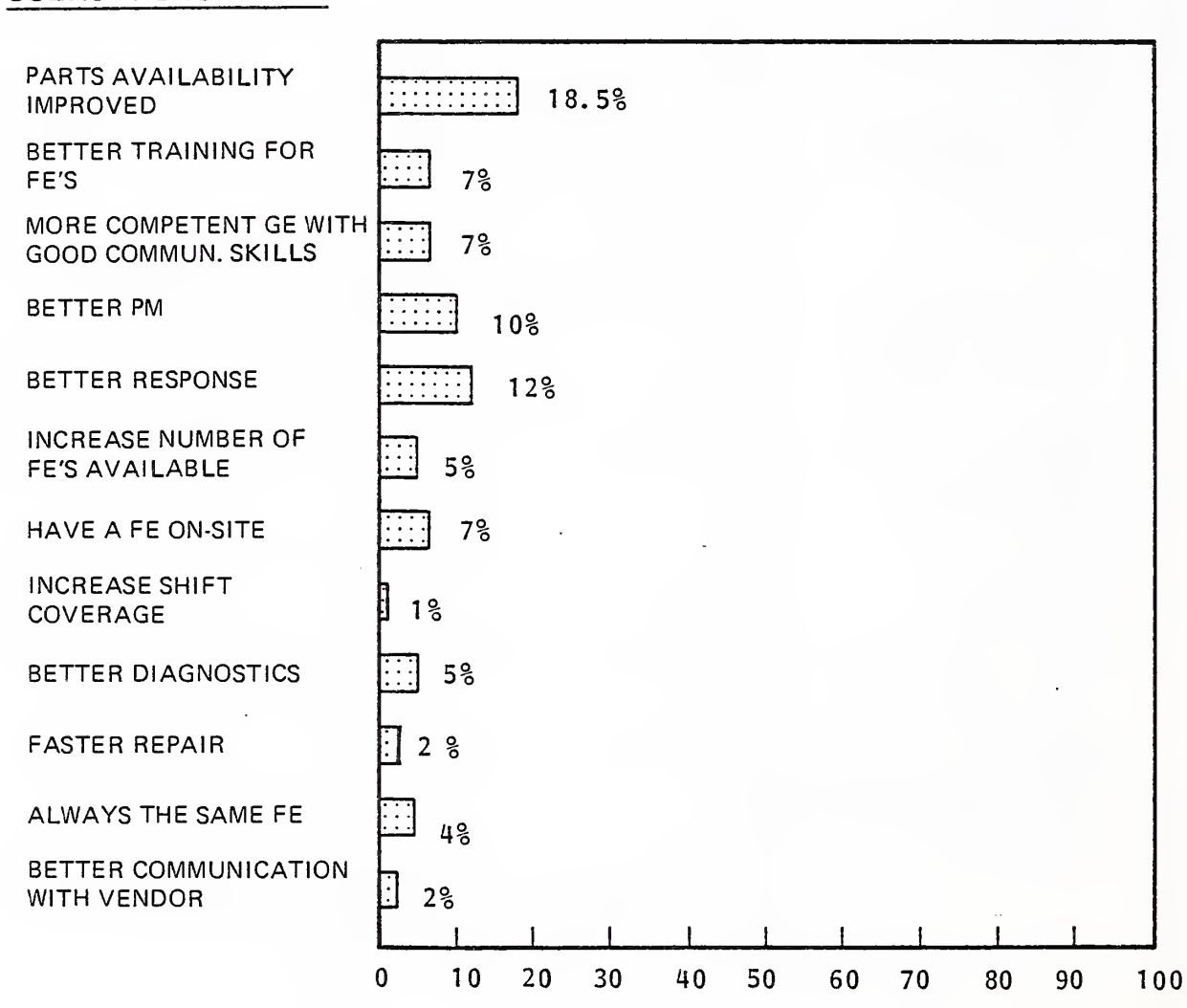

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EXHIBIT B-13

REASONS FOR RESPONDENT USERS' CONSIDERATION
OF UTILIZING THIRD PARTY MAINTENANCE SERVICE

U.K.

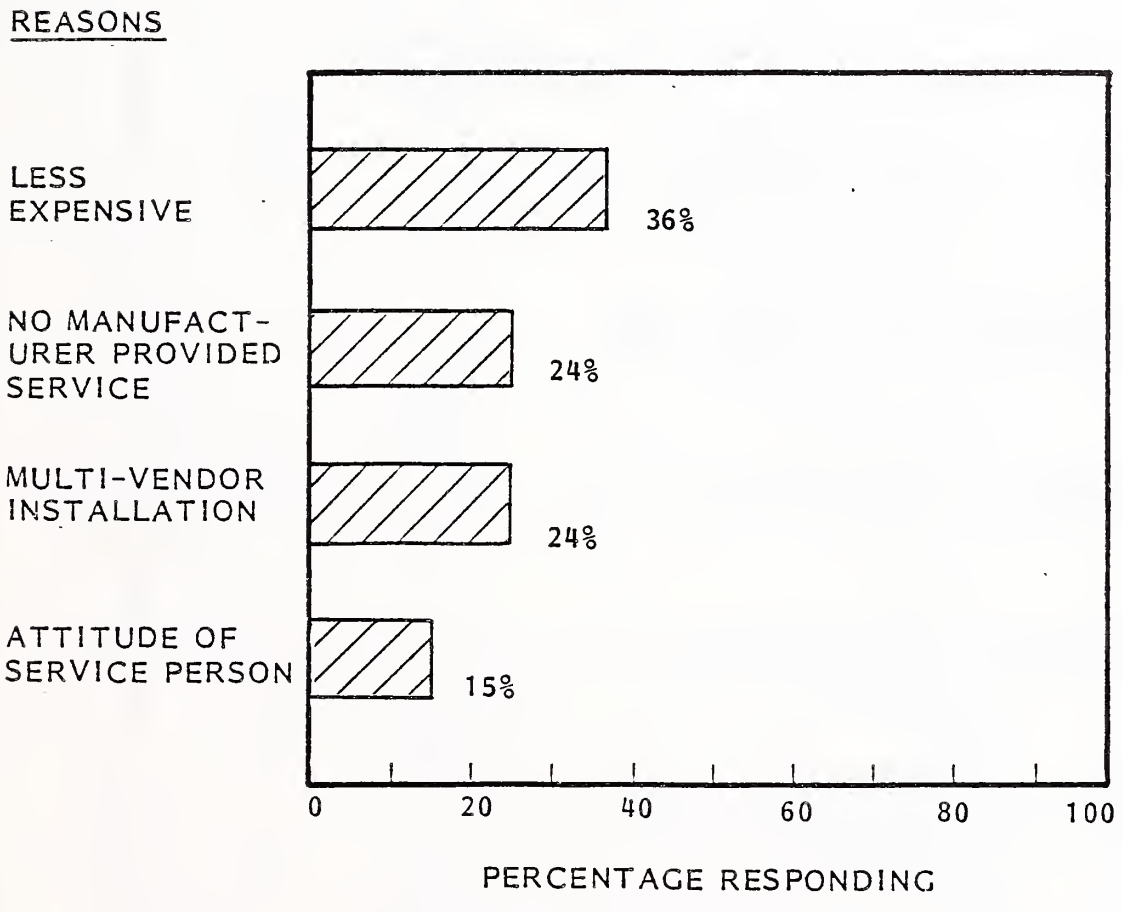

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EXHIBIT B-14

REASONS FOR RESPONDENT USERS' CONSIDERATION OF UTILIZING THIRD PARTY MAINTENANCE SERVICE

WEST GERMANY

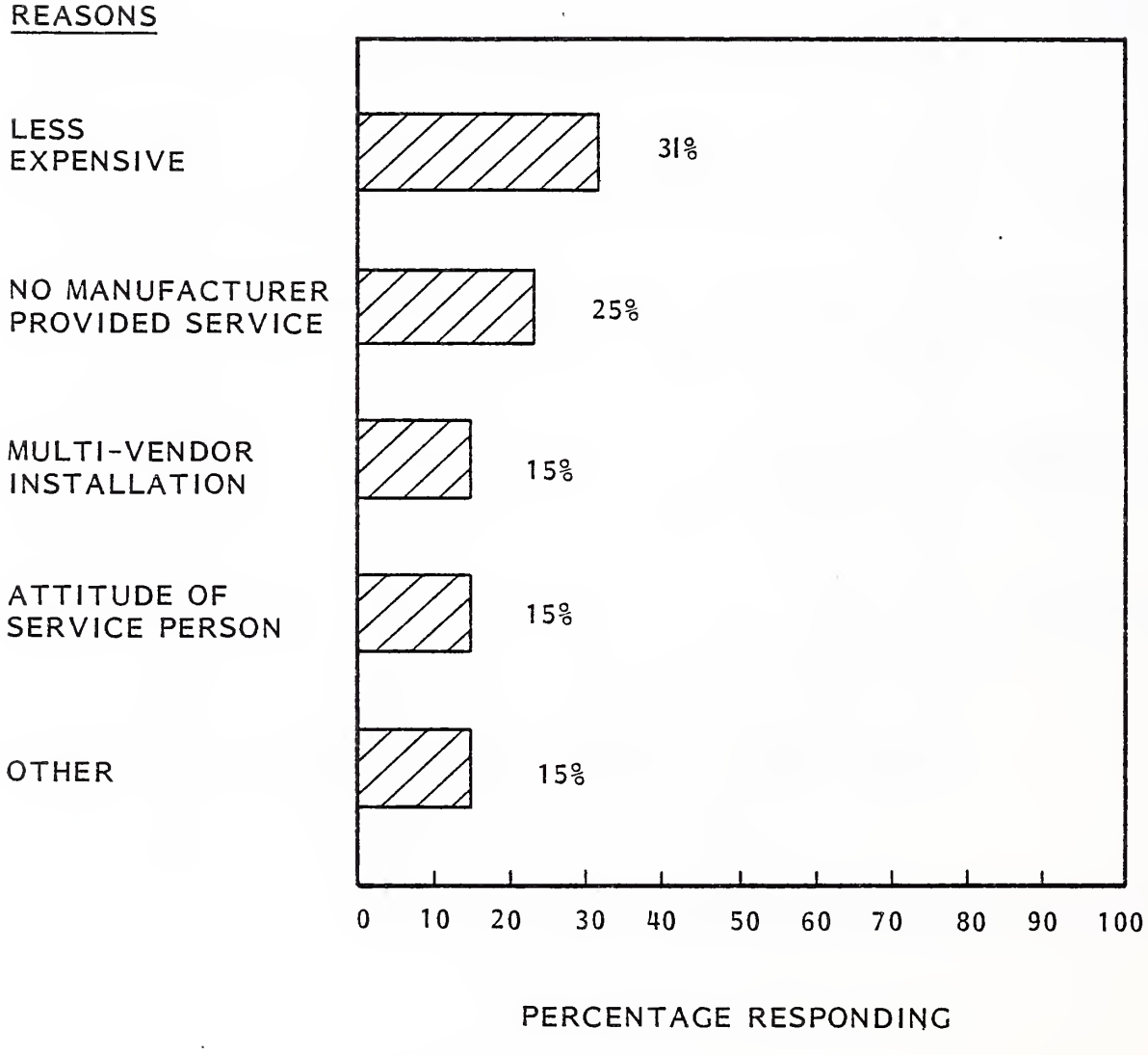

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EXHIBIT B-15

RESPONDENT USERS' PREFERENCE FOR CONTRACT OR TIME AND MATERIAL MAINTENANCE SERVICE
WEST GERMANY

EQUIPMENT CLASSIFICATION	VERY LARGE		LARGE		MEDIUM		SMALL	
	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT
LARGE AND MEDIUM MAINFRAMES	0	5	0	9	0	12	0	13
SMALL BUSINESS COMPUTERS	0	0	0	0	1	0	0	1
OTHER MINICOMPUTERS	0	1	0	0	0	0	0	0
PLUG COMPATIBLE PERIPHERALS	0	3	0	2	0	8	0	12
TERMINALS	0	4	0	7	0	9	0	10
TOTAL	0	13	0	18	1	29	0	36

NUMBER OF RESPONSES: 39

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RESPONDENT USERS' PREFERENCE FOR CONTRACT OR TIME AND MATERIAL MAINTENANCE SERVICE

U.K.

EQUIPMENT CLASSIFICATION	VERY LARGE		LARGE		MEDIUM		SMALL	
	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT	T/M	CON-TRACT
LARGE AND MEDIUM MAINFRAMES	0	8	0	15	0	19	0	14
SMALL BUSINESS COMPUTERS	0	4	0	6	0	9	1	2
OTHER MINICOMPUTERS	0	3	0	7	0	4	0	3
PLUG COMPATIBLE PERIPHERALS	0	7	0	6	0	4	1	5
TERMINALS	0	5	1	11	0	13	1	8
TOTAL	0	27	1	45	0	49	3	32

INPUT

EXHIBIT B-17

RESPONDENT USERS' PLANS FOR DISTRIBUTED DATA PROCESSING

EUROPE

SITUATION	NUMBER OF AFFIRMATIVE RESPONSES					PERCENTAGE OF AFFIRMATIVE RESPONSES				
	VL	L	M	S	TOTAL	VL	L	M	S	TOTAL
PRESENTLY INSTALLED	12	12	7	13	44	24	43	16	36	34%
PLANNED FOR: 1980	1	2	7	4	14	5	7	16	11	11%
1981	2	1	5	1	9	10	3.5	12	3	7%
1982	0	1	1	1	3	0	3.5	2	3	2%
1983	1	0	0	0	1	5	0	0	0	1%
UNDECIDED	1	7	12	9	29	5	25	28	25	23%
NEVER	4	5	11	8	28	19	18	26	22	22%
TOTAL	21	28	43	36	128	100%	100%	100%	100%	100%

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EXHIBIT B-18

RESPONDENT USERS' PLANS FOR DISTRIBUTED DATA PROCESSING

U.K.

SITUATION	NUMBER OF AFFIRMATIVE RESPONSES					PERCENTAGE OF AFFIRMATIVE RESPONSES				
	VL	L	M	S	TOTAL	VL	L	M	S	TOTAL
PRESENTLY INSTALLED	6	6	3	7	22	55%	35%	12%	41%	31%
PLANNED FOR: 1980	0	2	4	0	6	0	12	15	0	9
1981	1	0	2	1	4	9	0	8	6	6
1982	0	1	1	0	2	0	6	4	0	3
1983	1	0	0	0	1	9	0	0	0	1.5
UNDECIDED	1	6	11	7	25	9	35	42	41	35
NEVER	2	2	5	2	11	18	12	19	12	16
TOTAL	11	17	26	17	71	100%	100%	100%	100 %	100%

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EXHIBIT B-19

RESPONDENT USERS' PLANS FOR DISTRIBUTED DATA PROCESSING

WEST GERMANY

SITUATION	NUMBER OF AFFIRMATIVE RESPONSES					PERCENTAGE OF AFFIRMATIVE RESPONSES				
	VL	L	M	S	TOTAL	VL	L	M	S	TOTAL
PRESENTLY INSTALLED	2	5	3	5	15	40%	62%	25%	38%	39%
PLANNED FOR: 1979	1	0	1	0	2	20%	0	8%	0	5%
1980	0	0	2	2	4	0	0	17%	15%	11%
1981	0	0	0	0	0	0	0	0	0	0
1982	0	0	0	1	1	0	0	0	8%	3%
1983	0	0	0	0	0	0	0	0	0	0
UNDECIDED	0	0	0	1	1	0	0	0	8%	3%
NEVER	2	3	6	4	15	40%	38%	50%	31%	39%
TOTAL	5	8	12	13	38	100%	100%	100%	100%	100%

INPUT

EXHIBIT B-20

COST SAVINGS REQUIRED FOR RESPONDENT USERS TO ELIMINATE PREVENTIVE MAINTENANCE
U.K.

RESPONDENTS' REACTIONS	SIZE OF COMPANY				TOTAL
	VERY LARGE	LARGE	MEDIUM	SMALL	
WOULD NOT ELIMINATE	12%	21%	37%	21%	90%
WOULD FOR 5% OF CONTRACT COST	1	1	1	0	3
WOULD FOR 6-10% OF CONTRACT COST	0	0	0	2	2
WOULD FOR 11-20% OF CONTRACT COST	0	0	0	1	1
WOULD FOR 21-30% OF CONTRACT COST	0	0	1	0	1
WOULD FOR >30% OF CONTRACT COST	1	1	1	0	3
TOTAL	-	-	-	-	100%

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EXHIBIT B-21

COST SAVINGS REQUIRED FOR RESPONDENT USERS TO ELIMINATE PREVENTIVE MAINTENANCE
WEST GERMANY

RESPONDENTS' REACTIONS	SIZE OF COMPANY				TOTAL
	VERY LARGE	LARGE	MEDIUM	SMALL	
WOULD NOT ELIMINATE	12%	24%	26%	18%	79%
WOULD FOR 5% OF CONTRACT COST	0	0	0	3	3%
WOULD FOR 5-10% OF CONTRACT COST	0	0	0	0	0
WOULD FOR 11-20% OF CONTRACT COST	3	0	6	3	12%
WOULD FOR 21-30% OF CONTRACT COST	0	0	3	0	3%
WOULD FOR >30% OF CONTRACT COST	0	0	0	3	3%
TOTAL	15%	24%	35%	26%	100%

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EXHIBIT B-22

COST SAVINGS REQUIRED FOR RESPONDENT USERS TO ELIMINATE PREVENTIVE MAINTENANCE

HOLLAND

RESPONDENTS' REACTIONS	SIZE OF COMPANY				TOTAL
	VERY LARGE	LARGE	MEDIUM	SMALL	
WOULD NOT ELIMINATE	15%	23%	23%	15%	77%
WOULD FOR 5% OF CONTRACT COST	-	-	-	-	0
WOULD FOR 6-10% OF CONTRACT COST	-	-	-	-	0
WOULD FOR 11-20% OF CONTRACT COST	-	-	8%	8%	15%
WOULD FOR 21-30% OF CONTRACT COST	8%	-	-	-	8%
WOULD FOR >30% OF CONTRACT COST	-	-	-	-	0
TOTAL	-	-	-	-	100%

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EXHIBIT B-23

AVERAGE REPAIR TIME OF DISSATISFIED
RESPONDENT USERS
EUROPE

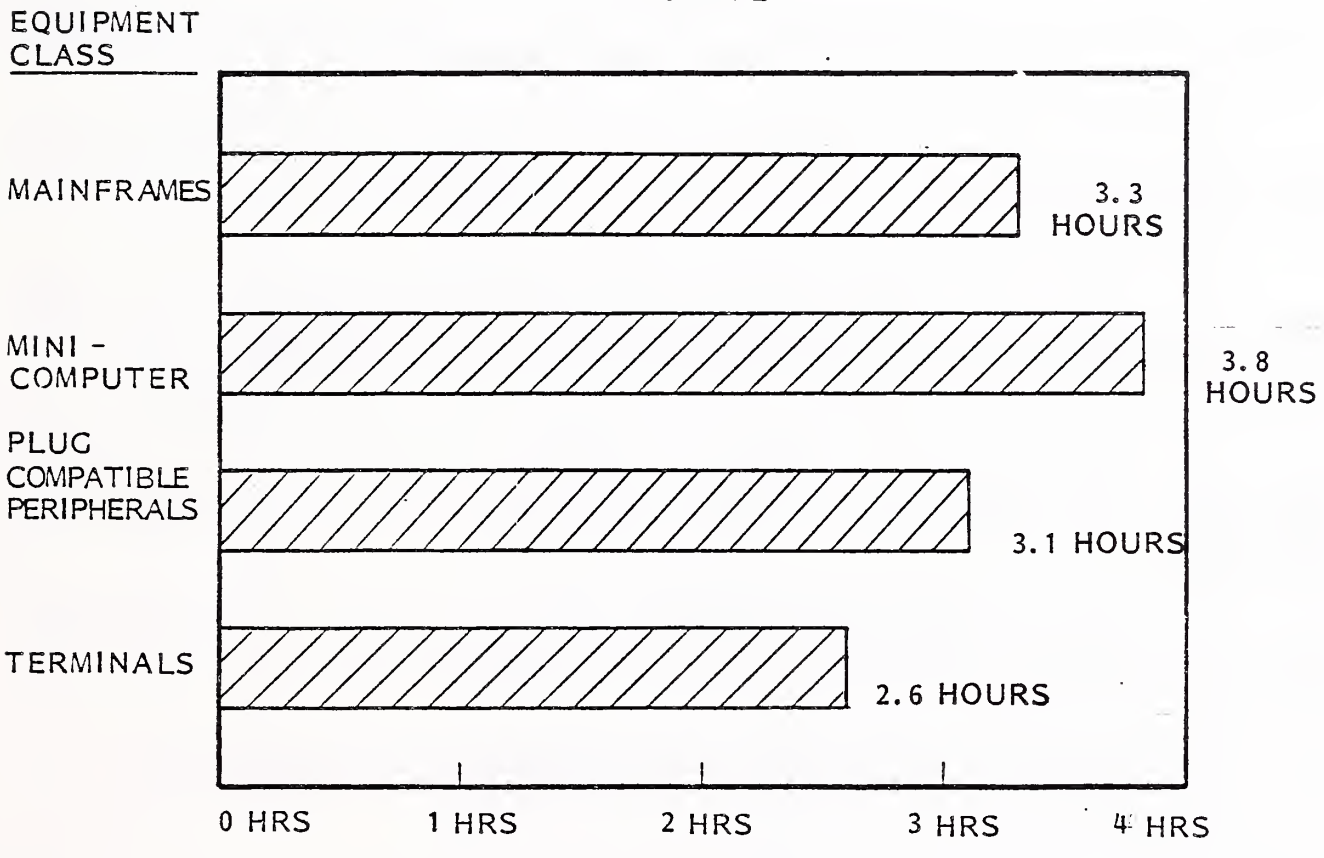

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EXHIBIT B-24

DESIRED AVERAGE REPAIR TIME OF
DISSATISFIED RESPONDENT USERS

EUROPE

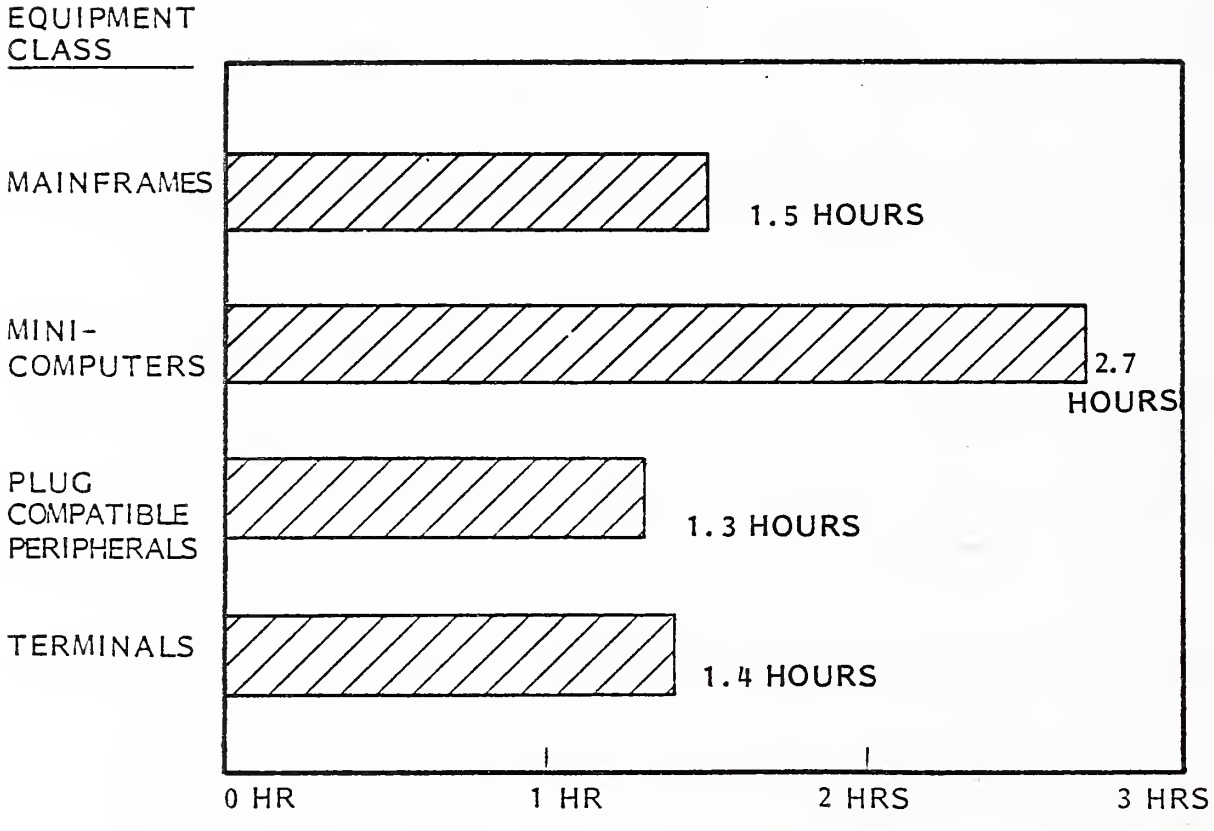

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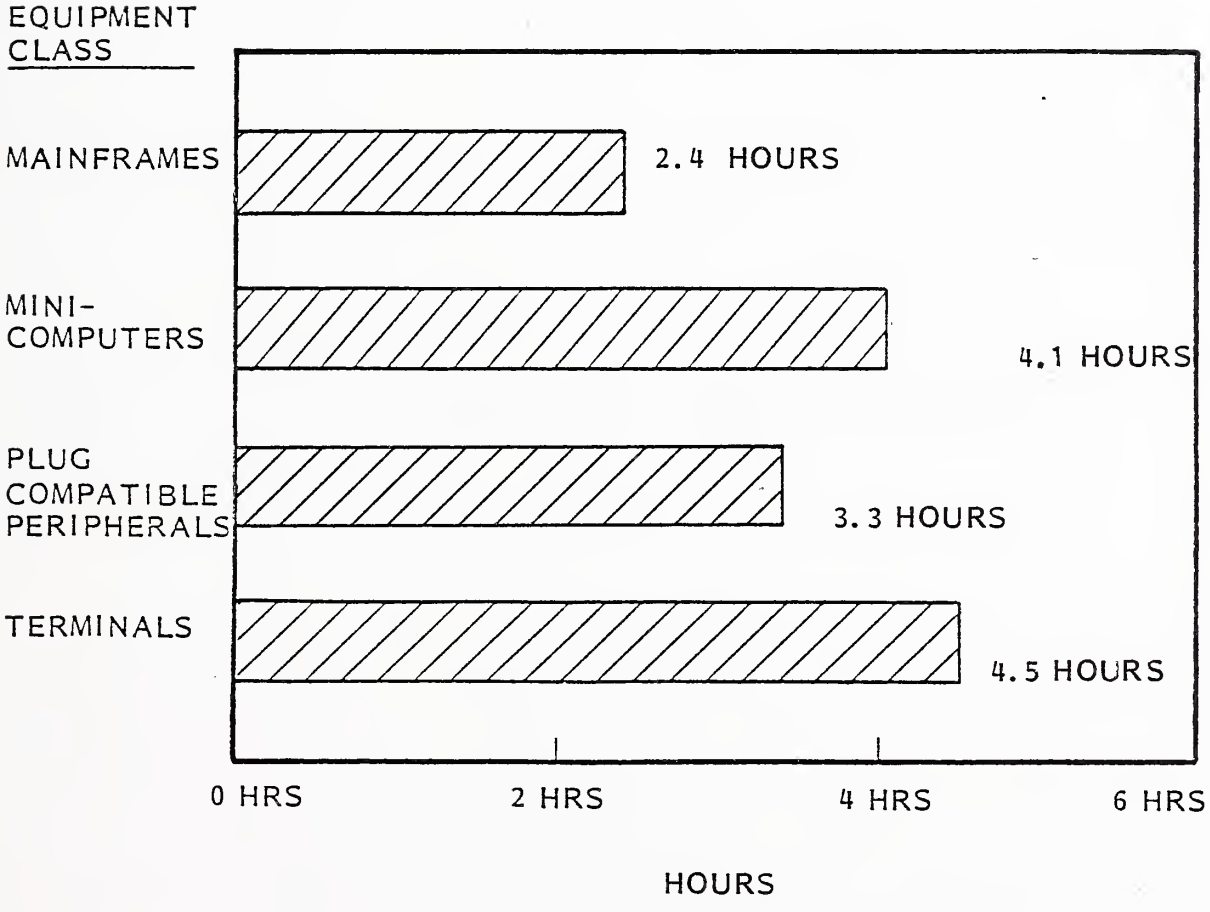
EXHIBIT B-25

AVERAGE RESPONSE TIME OF DISSATISFIED RESPONDENT USERS

EUROPE



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APPENDIX C: USER QUESTIONNAIRE

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CONFIDENTIAL

INPUT QUESTIONNAIRE

CATALOG. NO. M T U
SIC. CODE
SIZE CODE
AREA CODE
STUDY CODE
DATE MM DD YY

☐ ON SITE ☐ PHONE

STUDY TITLE: MAINTENANCE: INFO. PROC. INDUSTRY (X-MNT)
TYPE OF INTERVIEW: USER

INTERVIEWER: _____

COMPANY: _____ CO. TYPE: _____

ADDRESS: _____ SALES: _____

_____ # EMPL: _____

_____

_____

INDUSTRY

☐ DISCRETE MANUFACTURING ☐ UTILITIES ☐ INSURANCE

☐ PROCESS MANUFACTURING ☐ RETAIL ☐ GOVERNMENT – FEDERAL

☐ TRANSPORTATION ☐ BANKING ☐ GOVERNMENT – STATE & LOCAL

☐ MEDICAL ☐ WHOLESALE ☐ EDUCATION

☐ SERVICES ☐ OTHER

INTERVIEWS

NAME	TITLE	TELEPHONE NO.

SUMMARY

REFERENCES

USER INTERVIEW

1. Industry _____ .

2. Sales volume _____ .

3. SIC code (or Group) _____ .

4. Is this location:

   a) Part of a larger enterprise? ☐ Yes ☐ No

   b) An independent enterprise? ☐ Yes ☐ No

5. Functions performed at this location. (Check all that apply)

   a) R & D ☐ b) Manufacturing ☐

   c) Sales ☐ d) Warehousing ☐

   e) Accounting ☐ f) Administrative ☐

   g) Other (Describe) ☐

Financial and personnel data.

6. a) Total number of employees:

      i) At this facility _____

      ii) Under the jurisdiction of this facility _____

   b) EDP employees:

      i) At this facility _____

      ii) Under the jurisdiction of this facility _____

7. What is your EDP budget for 1978? $_____

1979? $_____

8. What percentage growth in the EDP budget do you foresee? (current dollars)

a) 1978 to 1979: _____ %

b) 1979 to 1980: _____ %

c) 1980 to 1981: _____ %

d) 1981 to 1982: _____ %

e) 1982 to 1983: _____ %

9. What is your projected distribution of EDP expenses? ($ and/or %)

Factor	(A) 1978	(B) 1980	(C) 1983
a) Medium/Large Systems	$ %	$ %	$ %
b) Mini/Small Business Computer Systems	$ %	$ %	$ %
c) Terminals	$ %	$ %	$ %
d) Data Communications	$ %	$ %	$ %
e) Personnel	$ %	$ %	$ %
f) Maintenance	$ %	$ %	$ %

* Eliminated detail for fortune 100/10 Companies.

10.

The Following Questions Relate To Your Total Organization	(i) Medium (370/125-140) & Large (158+) Mainframes (Total System)	(ii) Small Business Computers	(iii) Other Minicomputers	(iv) Peripherals (Plug Compatible) (Memory, Disk, Tape Drives)	(v) Terminals
* a) Describe units installed (Quantity, Make, and Model)					
b) Purchase Price or Monthly Lease Expense for Equipment Listed					
c) Monthly Maintenance Expenses (1978) for Equipment Listed (Ref: 9f)					
d) Anticipated Increase in Maintenance Expense (1978-1979)					

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11. Rate the importance to you of the following field maintenance characteristics: (5 = highest, 1 = lowest)

Factor	Rating	Rank 5s
a) Mean Time to Respond (in person)		
b) Mean Time to Repair (of equipment) (Not include response time)		
c) Performance of Preventive Maintenance		
d) Maintenance Expenses Increasing 8-10%/Year		
e) Account Control		
f) Other		

12. List the vendor performing maintenance (manufacturer, third party, user, etc.) for the following equipment, and rate your satisfaction with his performance (5 = excellent; 1 = very poor)

EQUIPMENT CLASSIFICATION	(i) MAINTENANCE VENDOR	(ii) RATING	(iii) USING TIME AND MATERIAL (TM) OR CONTRACT (C)
a) Medium and Large Mainframe Systems			
b) Small Business Computers			
c) Other Mini-Computers			
d) Peripherals (Plug Compatible)			
e) Terminals			

f) Comment on 12a-e (iii)

13. Would you prefer using: hardware vendor or third party for maintaining your systems as indicated (check appropriately)

EQUIPMENT CLASSIFICATION	(i) ONLY USE VENDOR	(ii) PREFER VENDOR	(iv) NO DIFFERENCE	(iv) PREFER THIRD PARTY	(v) ONLY USE THIRD PARTY
a) Medium and Large Main-frames system					
b) Small Business Computers					
c) Other mini-computers					
d) Peripherals (plug com-patable)					
e) Terminals					

14. Would you as a user, consider the following?

	Yes or No	Comment
a) Install equipment yourself.		
b) Cooperative testing by running diagnostics before calling vendor for maintenance help.		
c) Actually performing maintenance on your product or system.		
d) Deliver equipment to vendor maintenance depot for repair or replacement.		

e) Are you presently doing a, b, c, d? ☐ Yes ☐ No. Describe:

14. f) What percentage cost savings would you require for performing your own maintenance?

i) <10% _____

ii) 11-20% _____

iii) 21-30% _____

iv) >30% _____

v) Would not consider _____

g) What do you require for maintenance:

Coverage

i) Shifts/Day: _____

ii) Days/Week: _____

iii) Comments concerning the future:

15. Do you have distributed data processing (DDP) in your company now?

a) Yes _____

b) No _____

c) If "no," when are you planning to?

i) 19 _____

ii) Undecided _____

iii) Never _____

iv) If "never," why?

16. What do you consider as the minimum acceptable performance?

EQUIPMENT CLASSIFICATION	PERCENTAGE UPTIME (%)	MEANTIME BETWEEN FAILURE (HOURS)	MEANTIME TO REPAIR (HOURS)	MEANTIME TO RESPOND (HOURS)
a) Medium and Large Mainframes				
b) Small Business Computers				
c) Other Minicomputers				
d) Peripherals (plug compatible)				
e) Terminals				

17. What are you currently receiving and how much extra (%) would you spend for an improvement in mean time to respond (X) and mean time to repair (Y)?

Product Line	Mean Time to Respond(X)/Repair(Y) (Hours)		Absorb Extra Cost
	Present Actual (X/Y)	Required or Desired (X/Y)	(%)
a) Main Frame System	/	/	/
b) Small Business Computer	/	/	/
c) Mini - Computer	/	/	/
d) P.C. Peripherals	/	/	/
e) Terminal	/	/	/

18. Except for the initial installation, what device in your present equipment was down (outage) for the longest continuous period?

a) Type _____

b) Manufacturer _____

c) Maintenance Vendor _____

d) How long was the outage in elapsed hours? _____

Reason for outage?

e) Could this have been prevented? Yes _____ No _____

f) If "yes," how?

g) If "no," why?

19. a) Except for the mainframe(s), rate which group of devices are most disruptive when out of service: (5 = most, 1 = least) and rank 5 s.

FACTOR		RATING	RANK 5s
i	Console		
ii	Disk Drives		
iii	Tapes		
iv	Card Reader		
v	Card Punch		
vi	Printer		
vii	Com. Front End		
viii	Modems		
ix	Terminals		

19. b) In your opinion, which of the above units is down the most? _____ the least? _____

20. If you have multiple vendor's equipment installed, (main frames and peripherals), whose is down the most?

a) Vendor Name _____

b) Type _____

c) Maintenance Vendor _____

Whose is down the least?

d) Vendor Name _____

e) Type _____

f) Maintenance Vendor _____

21. During the last two years, have you or are you in the process of replacing any equipment because of poor maintenance?

a) Yes _____

b) No _____

c) If "yes,":

i) Vendor Name _____

ii) Type _____

iii) Maintenance Vendor _____

d) The availability (uptime) of the new equipment is:

a) Better _____

b) About the same _____

c) Worse _____

d) Not yet installed _____

22.a) List any vendors whose equipment you would refuse to consider in the future due to past maintenance problems:

b) Why?

23. Of the companies (manufacturer or third party) performing maintenance on your equipment, rate them overall and on the basis of their performing preventive maintenance (PM): (5 = very effective, 1 = very poor)

Company	Overall Rating	PM Performed (check)		Rating (PM)
		On Shift	Off Shift	
a)				
b)				
c)				
d)				
e)				

24. For what percentage of cost saving in your maintenance contract would you eliminate preventive maintenance (PM)? (Encircle)

a) Would not consider elimination of PM.

b) 5% of contract cost

c) 5-10% of contract cost

d) 11-20% of contract cost

e) 21-30% of contract cost

f) >30%

25. Rate the reasons for your presently using or considering using (encircle appropriately) a third party maintenance organization: (5 = highest, 1 = lowest)

Factor	Rating	Rank 5 s
a) Less Expensive (i) Minimum Percentage: _____%		
b) Manufacturer(s) does not provide service in area (i) Maximum Time to Respond Allowed Manufacturer: _____ hours		
c) Multi-Vendor Installation		
d) Attitude of Service Person		
e) Other Reasons for Dissatisfaction (e.g.:)		

26. What are your preferences as a user towards a maintenance person concerning the following factors?

(Prefer (P), Indifferent (I), Dislike (D))

Factor	Preference
a) Male	
b) Female	
c) Shirt and Tie (For Male)	
d) Shoulder Length Hair (for male)	
e) Uniform (Coveralls, etc.)	
f) Seems to be Constantly On Site (whether or not working)	
g) Usually the Same Individual Maintaining the Equipment	
h) Other	
i) Other	

27. What, in your opinion, would improve your maintenance service the most?

28. What maintenance needs or service requirements do you have which are not now being met?

29. Do you believe there are differences in maintenance requirements for the following product categories compared to "information processing equipment"?

a) Automated office equipment: ☐ Yes ☐ No

b) Comment:

c) PABX equipment: ☐ Yes ☐ No

d) Comment:

APPENDIX D: VENDOR QUESTIONNAIRE

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VENDOR INTERVIEW

1. Type of vendor (check appropriately): (encircle product(s) for this questionaire)

   a) Mainframe manufacturer _____

   b) Small business computer manufacturer _____

   c) Mini computer manufacturer _____

   d) Peripheral (plug compatible) manufacturer _____

   e) Terminal manufacturer _____

   f) Third party maintenance organization _____

   g) Computer services vendor _____

   h) Other (describe) _____

2. a) What is the title of the senior corporate maintenance executive?

   b) To whom does he presently report?

   c) To whom do you think he'll report in 1980?

   d) What functions report to him:

3. How many maintenance depots do you have, and where are they located?

4. How many field engineering locations do you have?_____

5. Number of employees in your maintenance organization:

   a) Total headcount: _____ (a = b+c+d)

   b) Field engineer count: _____

   c) Field management count: _____

   d) Administrative count: _____

6. What is the size of an average field location?

   a) Direct employees (maintenance engineers):

   b) Support personnel:

   c) Budgeted revenue/year:

   d) Budgeted cost/year:

7. We are interested in your source for obtaining, or means of training, field maintenance engineers for your organization. Please rate the importance of these sources (on a scale of 5 = highest number of people, 1 = lowest number of people) for 1978 and projected for 1982:

FACTOR	RATING (1978)	RANK 5s	RATING (1982)
a) Hire and train yourself			
b) Recruit from competition			
c) Recruit from other industries			
d) Trained discharged Armed Forces personnel			
e) Recruit from other functions within your company (e.g.: manufacturing, engineering)			
f) Trade Schools			
g) Other (describe)			

8. What are the 3 most important reasons for your losing (or separating) field maintenance engineers?

   a)

   b)

   c)

9. a) Do you have a formal training program for field engineers for:

   (i) hardware? ☐ Yes ☐ No

   (ii) software? ☐ Yes ☐ No

   b) If "No", why?

   (i) hardware:

   (ii) software:

   c) If "Yes":

Equipment	Average Training Days		Class Size	Cost Per Student Day (less travel and living)
	Hardware	Software		
(i) Medium/Large Mainframe				
(ii) Small Business Computer				
(iii) Mini Computers				
(iv) Plug Compatible Peripheral				
(v) Terminals				

9. d) Total number of student days: (if they don't know, then get # of classes taught per year)

(i) 1978 _____

(ii) 1979 percent increase: _____%

e) Number of Instructors:

(i) 1978 _____

(ii) 1979 percent increase: _____%

1978

10. a) Total new hires (field engineers): _____

b) Total separations (field engineers): _____

11. Additional (net) field maintenance headcount requirements anticipated:

	PERCENTAGE: increase/ decrease
a) 1979:	
b) 1980:	
c) 1981:	
d) 1982:	
e) 1983:	
f) Comments:	

12. a) Do you have an incentive program for field engineers?

☐ yes ☐ no

b) Describe:

13. At what "level" do you on-site replace or repair? (Check appropriately).

LEVEL	1978	1982	REPAIR LOCATION
a) component level			*
b) board level			*
c) unit level			

* (Plant (P), Depot (D), On Site (O)) (N/A for 1982)

14. Please estimate for December, 1978:

a) $\frac{\text{Spare parts investment (manufacturing or procurement cost)}}{\text{Value of units or systems maintained (manufacturing cost)}} = \_\_\_\_\_ \%$

b) Spare parts investment as a % of maintenance revenue _____ %

15. Please break down into the following categories all units or systems of your product line presently installed in Europe.

a) Maintained by your organization: _____ %

b) Maintained by a third party maintenance organization : _____ %

c) Maintained by the user : _____ %

d) Maintained by a distributor, systems house or integrator : _____ %

e) Other (describe) : _____ %

f) Don't know : _____ %

100 %

16. a) What <u>percentage</u> of total field engineering man hours was spent in installing ECNs (Engineering Change Notices) during 1978? _____%

b) Comments:

17. a) Average number of "trouble calls" monthly _____. (total # all units)

b) What percentage of (a) are "repeat calls"?_____% (Additional call within 2 week period.)

c) What percentage of (a) had no faults found? _____%

d) For (c) the customer is: (Check)

(i) Billed 100% of the time_____

(ii) Billed >50% of the time_____

(iii) Billed some of the time_____

(iV) Never billed _____

18. As you perceive it, rate the importance to your customer for the following field maintenance characteristics: (5 = highest, 1 = lowest)

(i.e., How important are the following field maintenance characteristics to your customer?):

FACTOR	RATING	RANK 5s
a) Mean Time to Respond (in person)		
b) Mean Time to Repair (of equipment)		
c) Performance of Preventive Maintenance		
d) Maintenance Expenses Increasing 8-10%/Year		
e) Account Management		
F) Other		

INP

19. What is the average estimated time that you provide to your customers for the products marketed:

EQUIPMENT CLASSIFICATION	PERCENTAGE UPTIME (PERCENT)	MEANTIME BETWEEN FAILURE (HOURS)	MEANTIME TO REPAIR (HOURS)	MEANTIME TO RESPOND (HOURS)
a) Medium and Large Mainframes				
b) Small Business Computers				
c) Other Minicomputers				
d) Peripherals (plug compatible)				
e) Terminals				

20. In your opinion, rate your maintenance operation in relation to competition for the following factors: (5 = excellent, 1 = poor)

FACTOR	RATING	RANK 5s
a) Personnel turnover		
b) Meantime (MT) to respond		
c) Meantime (MT) to repair		
d) Meantime (MT) between product failure		
e) Total customer satisfaction		
f) Other		

21. a) Do you presently use a third party maintenance organization for maintaining any of the products your company markets?

☐ Yes ☐ No

b) If "no," under what conditions would you consider it?

c) Would you consider maintaining products other than those marketed by your company?

(i) already do _____

(ii) yes _____

(iii) no _____

d) Would you want your customer to diagnose faults in his equipment?

☐ Yes ☐ No

e) Do you think your customer will deliver his faulty product to a maintenance depot for repair or replacement?

☐ Yes ☐ No

22. Rate the following factors as they present problems in your maintenance organization: (5 = most important; 1 = least important) (get 2-3 most important, at least)

FACTOR	RATING	RANK 5s
a) Morale of maintenance force		
b) Recruiting field maintenance personnel		
c) Training field maintenance personnel		
d) Reducing labor turnover		
e) Product quality		
f) Adequate diagnostic equipment		
g) Adequate remote diagnostic assistance		
h) Marketing demands		
i) Customer demands		
j) Budget limitations		
k) Salary Administration		

23. What maintenance revenues are forecasted for the product lines and years indicated? (Complete for products within interviewers responsibility.)

PRODUCT LINE	1978	1980	1982
a) Mainframe System	$	$	$
b) Small Business Computers			
c) Mini-Computers			
d) P.C.P.			
e) Terminals			

24. Do you consider (in your company) maintenance as a

a) Profit generator _____

b) Cost Center _____

c) Comments: (Interviewer comments especially important here)

d) What do you estimate is the 1978 maintenance profit/(loss) for the product line(s) surveyed?

Profit _____ Loss _____

25. What is your cost estimate for an average service call and how is it built up?

a) Labor $_____

b) Travel $_____

c) Part and Materials $_____

d) Other (describe) $_____

e) Total $

26. What are the formulas or ratios for the following maintenance arrangements:

FACTOR	HARDWARE	HARDWARE & SOFTWARE
a) Time and materials :	$	$
b) One shift x 5 days :	100 %	100 %
c) 2 shifts x 5 days :	%	%
d) 3 shifts x 5 days :	%	%
e) 2 shifts x 6 days :	%	%
f) 3 shifts x 6 days :	%	%
g) Other (describe) :	%	%

27. What is the 1978 average percentage for:

What is the average maintenance charge/year? _____

What is the average purchase price of equipment? _____ } = _____%

a) Mainframe System _____%

b) Small Business Computer _____%

c) Mini-Computer _____%

d) P.C.P. _____%

e) Terminals _____%

28. What changes in maintenance techniques do you foresee as a result of rising labor costs and increasing product/price performance:

a) 1979:

b) 1982:

c) 1985:

29. Rank the following factors as to what you believe will be their impact over the next 5 years on your presently used maintenance techniques (5 = greatest impact, 1 = no impact)

FACTOR	RATING	RANK 5s
a) Rising labor costs		
b) Increasing product price performance		
c) User performing own maintenance		
d) User and vendor cooperatively testing transmission or computing equipment		
e) Home or personal computers		
f) Multi-function equipment		
g) Built-in diagnostics		
h) Remote diagnostics (via telecomunications)		
i) Distributed data processing		
j) Advances in technology		
k) Other (describe)		

30. Please discuss the factors rated "5" in the previous question:

a)

b)

c)

31. In your company, who "sells" maintenance contracts?

a) Salesman _____

b) Maintenance representative _____

c) Other (describe)

d) Is there a commission plan: ☐ Yes ☐ No

e) If "Yes" to d), describe:

32. a) Do field maintenance engineers sell other products? ☐ Yes ☐ No

b) Describe

33. What indices do you use to measure field engineer productivity?

34. What do you believe would do the most in improving the services currently provided to your user?

Thank you very much!